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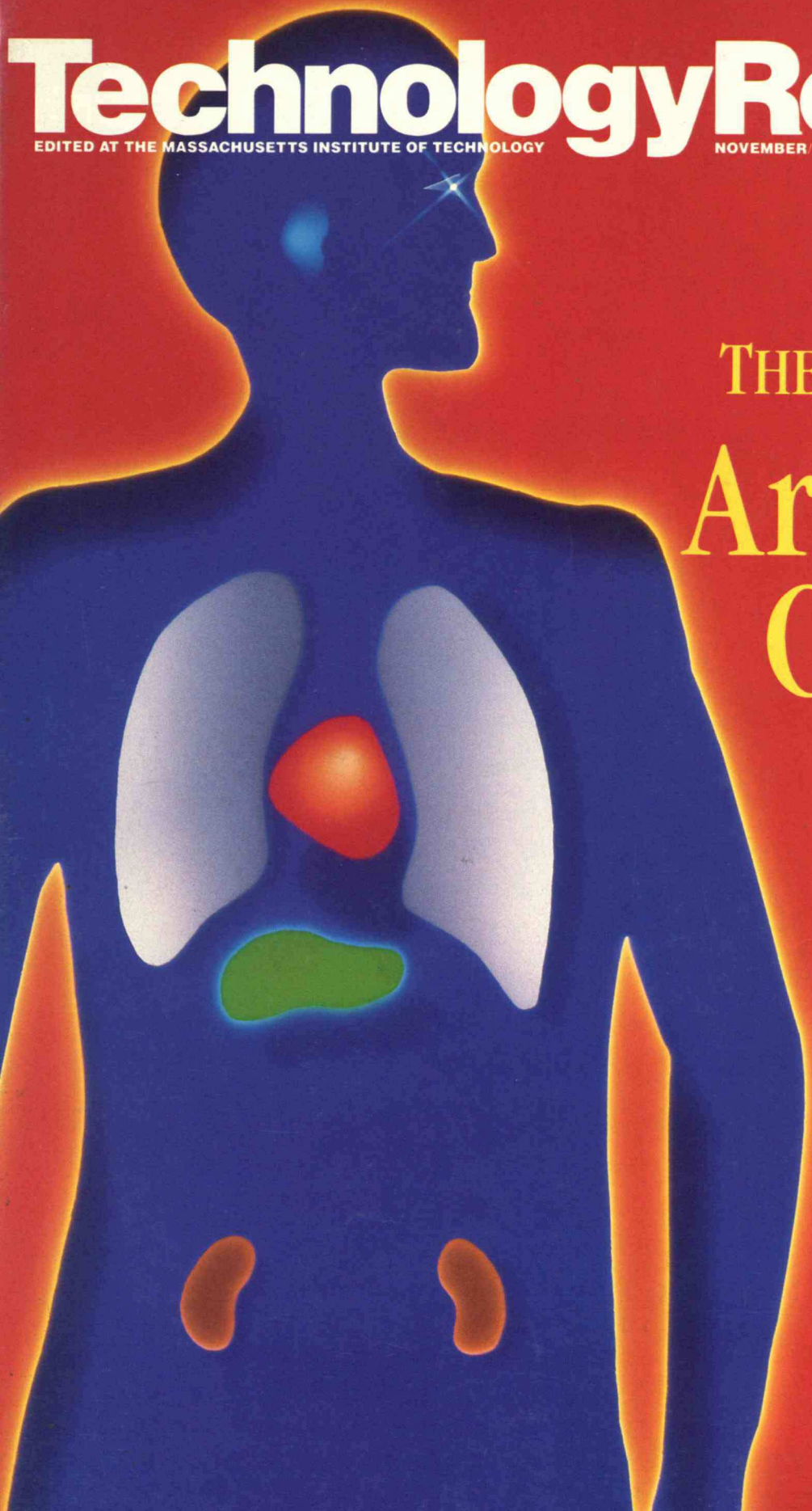
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Technology Review

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NOVEMBER/DECEMBER 1988

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THE PROMISE OF Artificial Organs

PIERRE M. GALLETTI

Too Much Regulation May Be Hazardous To Your Health

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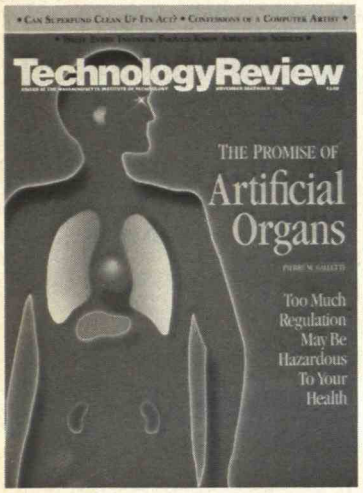
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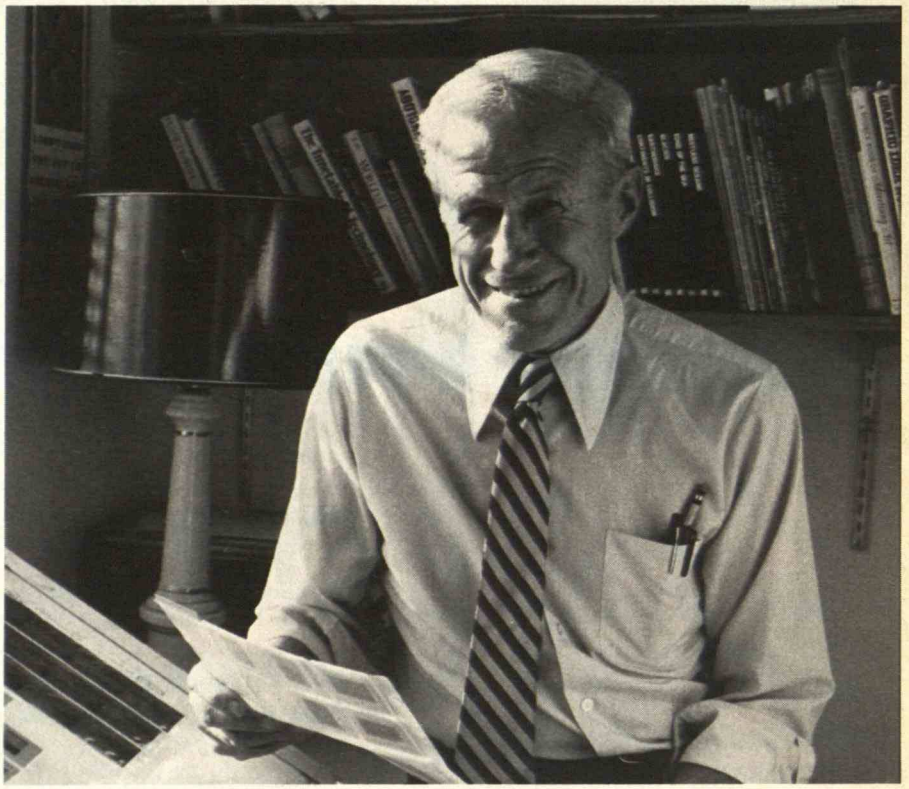
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FROM THE PUBLISHER

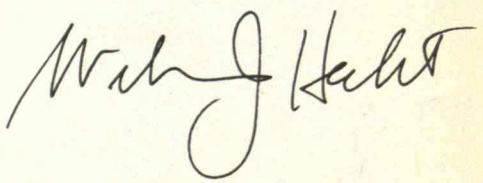
Tribute to John Mattill



WHEN editors retire, it is fitting even for publishers who believe in maintaining silence to speak up. Long-time readers of this magazine may think that John I. Mattill's name has always been associated with *Technology Review,* but not quite. John's first recorded impact on this publication is the mention of him on the masthead of the November 1959 issue. He became editor-in-chief with the November edition of 1966. Thus, the *Review* has benefited from his tireless dedication and energy for almost a third of its life.

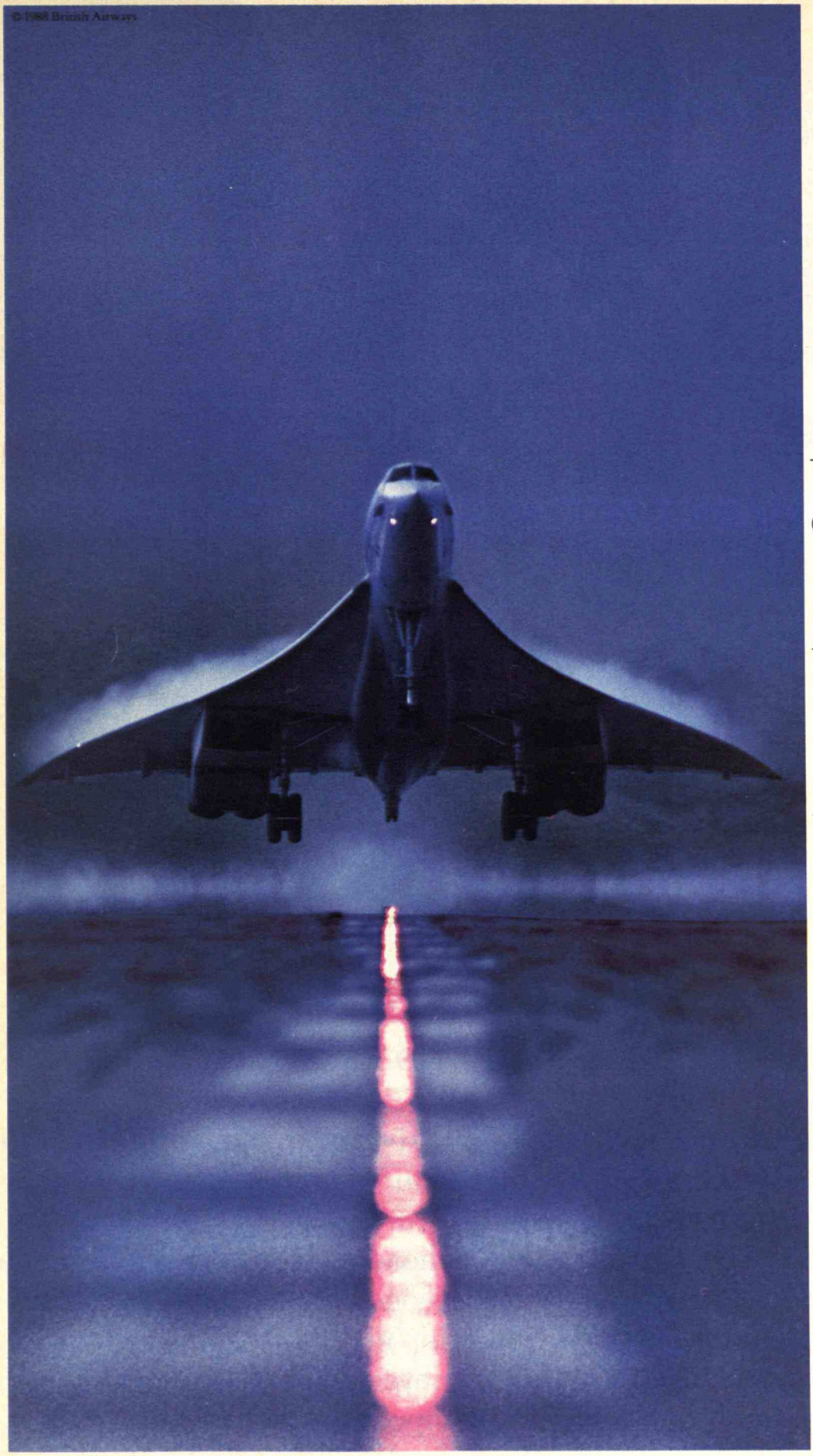
He was and is driven by a desire to make *Technology Review* achieve the standards of quality set by its parent institution, MIT. In so doing he has led us all to remarkable heights of accomplishment. During his tenure the magazine became a widely quoted and world-recognized asset to MIT. He led us to two selections as a finalist in the national magazine awards (a first for a university-based publication), numerous citations by other university magazines, and the publication of editions in both Japanese and Italian. Along the way he has helped develop numerous young editors and even educate a publisher now and then.

To those of us who have the privilege of knowing John, he remains the challenging, intense, and caring man he has always been. He joins the ranks of those who have taken something at MIT and shaped it into a practical realization of the institution's guiding principle: to make science and technology work for the benefit of society. His legacy is the very high standard he has set for the magazine, one by which those of us remaining on deck will be measured. John will continue to work for the magazine, but the baton is passed, and our debt to his leadership is large. □



WILLIAM J. HECHT

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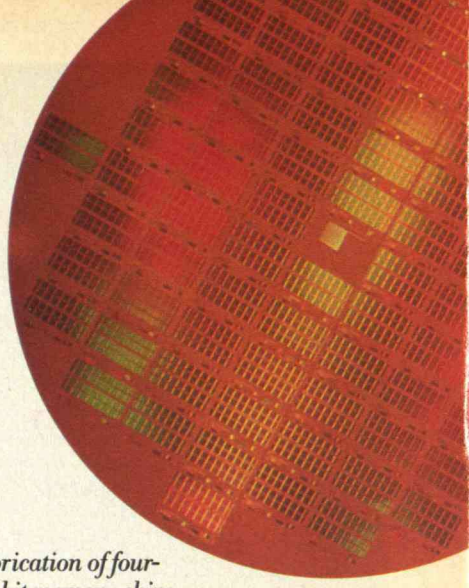
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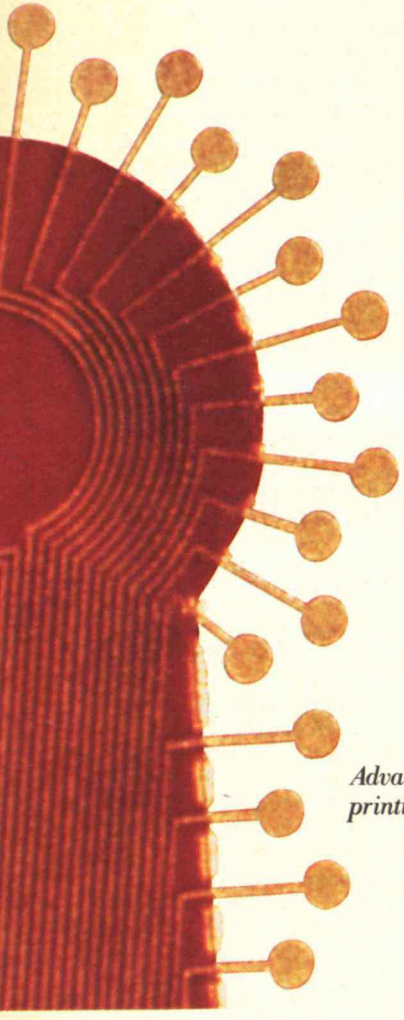
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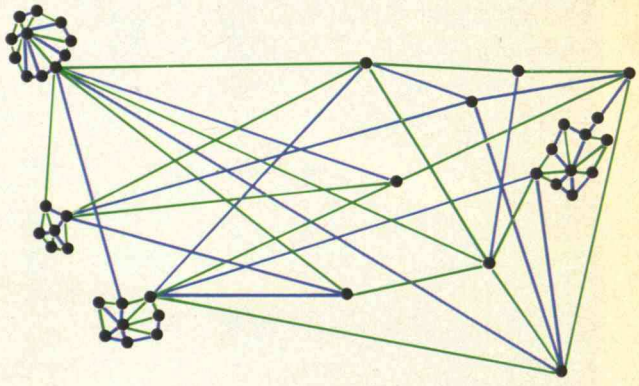
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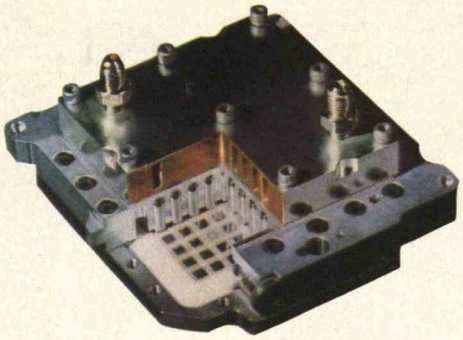
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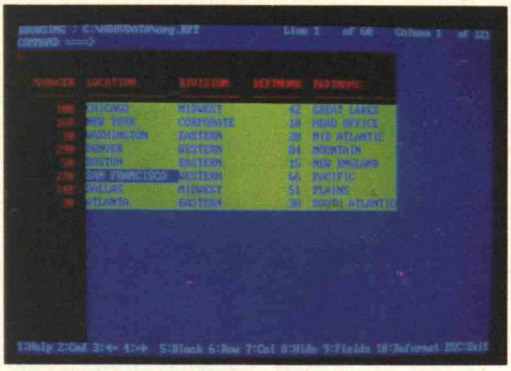
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APPRAISING ECONOMIC MIRACLES

In "Second Thoughts on the Massachusetts Miracle" (*July 1988*), Bennett Harrison is concerned about the inequality the state's prosperity has generated. But inequality is often the price one pays for economic growth. Even the Japanese, not to mention the Chinese, are discovering this fact. Under Mao Tse Tung equality meant equal poverty for all. That is what Deng Xiao Ping is trying to change.

Harrison also notes that from 1977 to 1986 only one out of six new jobs was in high technology. However, we know that new manufacturing jobs accelerate the creation of other jobs. Boston is now filled with high-rise buildings. Those high-rise buildings are filled with executives, lawyers, and financiers servicing the industries of Massachusetts. In 1974 only 7 of the Fortune 500 had their quarters in the state. Today the figure is 19, and approximately 12 of those firms can be considered high tech. Economic growth is expanding outward from Boston, and in cities like Lowell unemployment rates of 15 percent or more have dropped to 4 or 5 percent. Moreover, the unemployment rate among Blacks in Massachusetts is one of the lowest in the country.

Another of Harrison's complaints is that a good portion of the economic activity depends "either directly or indirectly" on Department of Defense procurement. Certainly if the government buys computers, that provides a market for the manufacturers in the state. But such a situation is a bit unfair to criticize.

Finally, American industry has generally suffered because of competition from the Far East, so it should not be surprising that some industries have suffered in Massachusetts, including those in high technology. Harrison should ask himself what the state would be like without the surge in private high technology that seems to upset him so.

MARSHALL I. GOLDMAN
Cambridge, Mass.

Marshall I. Goldman is associate director of the Russian Research Center at Harvard University.

The author responds:

According to Nobel laureate economist Simon Kuznets, income inequality rises during the takeoff from underdevelopment, and then declines under mature industrialization. Thus, the current trend toward rising inequality in mature Massachusetts (and the United States) is a puzzle—as well as a sociopolitical concern.

Yes, high-tech manufacturing generates a desirable demand for everything from office buildings to paper clips. But such an effect is not unique to this sector: so do the insurance companies and the hospitals that "export" their products to large numbers of non-Massachusetts citizens. And although low unemployment rates are to be applauded, those in Massachusetts are as much the result of stagnant labor-force growth as of job creation. Also, while the boom has indeed extended north to Lowell, it has not spread nearly as much to the towns west of Route 495.

The dependence of high-tech industries on Defense Department procurement is a problem because rational policy calls for military cutbacks. Moreover, some of us prefer large military cutbacks and are therefore genuinely concerned about how to wean the state's high-tech companies off the Pentagon.

I am not aware of being "upset" by the surge in private high-tech activity. Quite the contrary—I believe that one task of industrial policy ought to be to secure greater high-tech expansion. How? By convincing mature industries to retool and by encouraging national and state governments to promote the development of mobile health clinics, modular housing, light-rail vehicles, and other projects. That would create demand for what the high-tech companies have to sell.

Continued on page 78

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TRENDS



The Return of Scientific Ballooning

With space-shuttle delays, balloons have become invaluable for scientific research.

The oldest means of human flight may be today's most reliable way to investigate the stars. In the face of a string of high-technology mishaps, "low"-tech scientific balloons are helping keep U.S. space research aloft.

Able to lift instruments 25 miles, "the balloon platform gets you above 99.7 percent of the atmosphere," says Marvin Leventhal, a principal researcher in Bell Laboratories' astrophysics department. He has used balloons extensively for gamma-ray studies of supernova evolution and the physics involved. "If that's close enough to space to do your research work, it's *much* less expensive, much quicker to design, build, and fund" than the shuttle or a satellite, he explains.

Balloons also offer a stable ride that cannot be matched on rockets or airplanes. And Bob Kubara, project engineer at NASA's National Scientific Balloon Facility (NSBF) in Palestine, Tex., adds that his group uses a staff of only about 15 people to launch a heavy-payload balloon. Perhaps the world's leading balloon operator, NSBF has launched about 50 or 60 scientific experiments this past year.

Most important, scientific ballooning is a bird in the hand. "You can usually budget, fund, and fly a balloon within a year," says Patrick Cannon, engineering manager at Raven Industries, NASA's major supplier. By comparison, Harvey Needleman, chief of NASA's balloon program, estimates that the wait for orbital launch is several years. Research scientists are even more pessimistic. "There's something like a 10-year wait now between conceiving of a satellite and getting it funded and into space," says Leventhal.

Such responsiveness is key to taking advantage of unexpected research opportunities. A satellite may have only one window every month to get its cargo into a specific orbit, but balloons can go up as long as the weather is right. After the discovery in 1987 of a supernova visible only from the Southern Hemisphere, several teams quickly set off for Alice Springs in Australia's Northern Territory, taking balloons along to launch their apparatus.

According to Leventhal, the supernova research is "probably the largest balloon campaign ever mounted in the Southern Hemisphere." In one joint project, scientists from Bell Labs, Sandia Labs, and NASA built a new instrument called a gamma ray imaging spectrometer (GRIS). Flown over Alice Springs, GRIS is one of the few instruments capable of detecting gamma rays from the supernova. The data it gathers help verify or refute theories on the evolution of supernovas. NSBF also sent a team to Alice Springs, and Needleman says NASA is seeking to continue its scientific ballooning there with funds originally planned for other programs.

High-Tech Ballooning

Central to the resurgence of scientific balloons is their improved reliability, which follows a string of unexplained failures in the early 1980s. In 1986, NASA launched a series of test balloons made of Astrofilm E, a new polyethylene film Raven Industries had developed. Astrofilm E can better survive the rigors of the upper atmosphere, since it is tougher at low tem-

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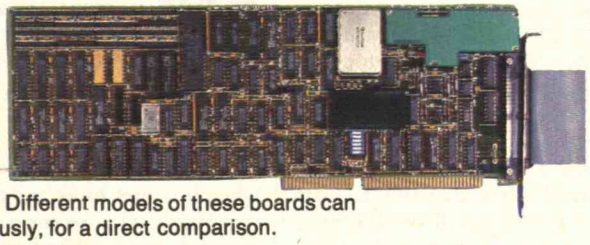
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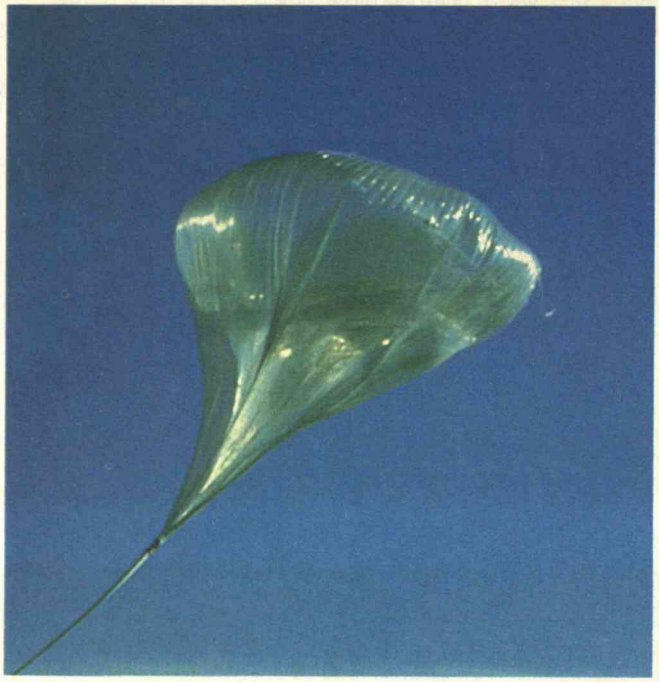
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Thanks to new materials, scientific balloons can maintain their strength in colder weather.

peratures. Moreover, its cold-brittleness point—the temperature at which it will shatter—is about −92°C or lower. Stratofilm, made by Winzen, NASA's other major supplier, was the previous standard at about −80°C.

Astrofilm E costs more, however, because it is "more difficult and slower to process," says Cannon. Even so, scientific balloons are cheap compared with the shuttle. A large balloon costs $50,000 to $70,000. Unlike the shuttle, a balloon is not reusable, but its payload is.

Improved cold-weather performance allows large balloons to go places they couldn't before. The Air Force Geophysical Lab (AFGL) has taken them to Antarctica as part of research on the hole in the ozone layer. In January, the AFGL, University of Florida, and NASA's Goddard Space Center flew an 11.8-million-cubic-foot balloon from Antarctica's McMurdo station.

Balloons do have drawbacks. Usually they can stay aloft for only two days. NSBF project manager Art Gilcrease says the average flight lasts 4 to 20 hours, depending on the needs of scientists. Cannon points out that with the right environment—temperature and so on—some flights in the Southern Hemisphere "have lasted for 12 days. But 48 [hours] is generally the maximum expected." Unless a balloon is a "superpressure"—sealed, with controllable vents—it has a built-in limitation: as its helium cools near sunset, ballast must be dropped to maintain altitude. Then as the helium heats up again the next day, some gas must be released. Nor can superpressures be used all the time, since they cost more and use a polyester film that has less elasticity.

Another problem is that, like the shuttle, scientific balloons have demanded close-to-perfect weather. But a recent Raven test flight carried 1,200 pounds to about 82,000 feet from the deck of a ship in a 20-knot wind. In the approach used for this flight, a smaller balloon—about 1 million cubic feet—lifts a larger one packaged inside a cannister. Near the desired altitude, the helium from the smaller balloon is channeled into the larger one, which has room to expand and climb farther. Such a system would make balloons easier to use in hostile environments like Antarctica.

With continuing shuttle delays and all the advantages scientific balloons have to offer, sales are booming. Last year, Raven sold over 30 balloons measuring between 10 million and 30 million cubic feet. Orders for balloons that can lift up to three tons have doubled since 1986, and the firm is building a new manufacturing plant and laboratory to meet the demand. □

MAUREEN MULLEN is East Coast editor of Balloon Life *and a world-record holder in flying gas balloons.*

Student Scientists

Six scientists stared at maps showing wind patterns and concentrations of acid emissions. One investigator leaned forward: "See, when the wind comes in, they get just a little acidity. But when it comes to us, we get a lot. That's why we measured so much more acid rain than they did."

Atmospheric scientists reviewing the latest national data? No, these are fifth graders in the Bowman School in Lexington, Mass., and the data come via computer from other "scientists" thousands of miles away. Both classes are in the midst of a six-week course on acid rain.

In the past few weeks, the students have tested the acidity of substances ranging from lemonade to shampoo; compared the effects of acidic vinegar and neutral water on pennies, plants, and seashells; and measured the acidity of rain as well as pond and tap water. Using an Apple IIGS computer, they have shared the results with collaborators at 200 schools in the United States, Canada, Mexico, Argentina, Hong Kong, and Israel. They have also discussed the results with John Miller, deputy director of the National Oceanic and Atmospheric Administration's Air Resources Laboratory.

The curriculum is part of a National Science Foundation (NSF) program to upgrade elementary school science education—the biggest such U.S. program since the post-Sputnik era three decades ago. Recent studies have shown that U.S. school children rank low in science skills and that many adults don't understand such basic terms as "radiation." Thus, NSF's challenge to scientists, textbook publishers, and curriculum developers to find ways to inspire students.

Robert F. Tinker is project director at the Technical Education Research Centers (TERC) of Cambridge, Mass., which developed the "Kids Network" curriculum in collaboration with the National Geographic Society. He believes that students should be "doing" science, investigating real problems for which the texts have no results.

Tinker wants children to experience the "excitement of exploring the unknown, of discovering something new," that motivates many scientists. In the process, they can learn basic skills—how to ask meaningful questions, collect data accurately, organize information, and use observations to answer questions.

Tinker and his colleagues are preparing the Kids Network with funds from NSF and National Geographic, with each providing $2.5 million over four years. Apple, Inc., is loaning computers to the schools participating in field tests. The only cost to the

PHOTO: RAVEN INDUSTRIES

schools is for providing telephone lines. The price of the completed curriculum has not been set, but all participants say they are committed to keeping it affordable.

The curriculum is composed of six-week units that involve fourth, fifth, and sixth graders in cooperative experiments. Students telecommunicate their results to a central computer, which pools the information and sends it back in tables, charts, and color-coded maps for the class to analyze and interpret. A cooperating scientist for each unit helps the students interpret the combined data.

In addition to the acid-rain unit, TERC field-tested an introductory unit last fall at 200 schools. That unit is designed to familiarize teachers and students with telecommunications and with collecting and analyzing simple data. Future units will examine weather, land use, biological diversity, health, and air and water pollution.

A Larger World

The response to the Kids Network has been generally enthusiastic. Chris Scanlon, a fifth-grade teacher in Lexington, is impressed with the acid-rain unit partly because "many of the things we look for in science—predicting, observing, experimenting—are very obvious here." In one 45-minute class, the students practice geography, data analysis, reasoning, and teamwork. They use latitudes and longitudes to locate schools that report acidity readings, and they predict measurements for other schools. And like all scientists, the students solve unexpected problems—"Where is Delaware?"

For students from rural Georgia to suburban Boston, the computer link can provide a sense of a larger world, and not only through shared data. Using their computer, a class can send a letter to all the classes on the network, or individuals at different schools can exchange letters. They can even collaborate. After immersing chalk in vinegar, a Dorchester, Mass., class reported the dramatic results to the network—and asked what others had tried.

Not surprisingly, the field tests have also revealed problems. Hardware and software have both been balky occasionally. Teachers unfamiliar with computers are sometimes intimidated, and certain activities require extensive teacher preparation. And some teachers have trouble adding new projects to already crowded schedules.

Linda Roberts, project director of the educational technology study of the Office of Technology Assessment, sees the Kids Network as a "very exciting development" but cautions that it is early to pass final judgment. She notes a potential future problem: getting the curriculum into wide use. TERC foresees the Kids Network in 10,000 classrooms, but past efforts to spread curricula that have looked successful in small-scale tests have frequently failed.

"That's where the National Geographic Society comes in," says TERC communications director Peggy Kapisovsky. National Geographic, which reaches a large audience with many school materials, will take on production, marketing, and distribution when the units are complete.

The final judgment also hinges on whether the curriculum can increase the nation's knowledge of important science concepts. Early indications are promising. Instead of seeing heads nodding over textbooks, teachers are finding that students are reluctant to leave when the bell rings. □

NANCY W. STAUFFER is a free-lance science writer and the editor at M.I.T.'s Energy Laboratory.

These Washington, D.C., sixth graders are using a new computer network to study the equator.



PHOTO: NATIONAL GEOGRAPHIC SOCIETY

Mission to Earth

This past spring, most of the world's top space-agency officials quietly convened deep in the New Hampshire woods. By the end of the three-day weekend, they had unanimously decided to pool their talents, but on an unusual space mission. The group fixed its collective gaze on neither distant galaxies nor neighboring planets, but rather upon the earth.

In the largest gathering of its kind, the conference laid the foundation for an earth-monitoring mission that would be a central component of the International Space Year (ISY) scheduled for 1992. The date will mark the thirty-fifth anniversary of the International Geophysical Year, which helped usher in the space age, and the five-hundredth anniversary of Columbus's voyage to America.

Sixteen nations and the European Space Agency sent representatives, including the heads or deputy heads of space agencies in the United States, Soviet Union, Japan, China, France, Britain, and West Germany. In the face of mounting international concern over global environmental threats, the officials agreed, on behalf of their governments, to undertake a coordinated effort to study the planet's well-being.

The daunting array of those threats—including pollution, deforestation, acid rain, and the depletion of the ozone layer—kept the mostly closed-door meeting, in the words of one French official, "down to earth." Throughout the gathering, the participants noted that the various

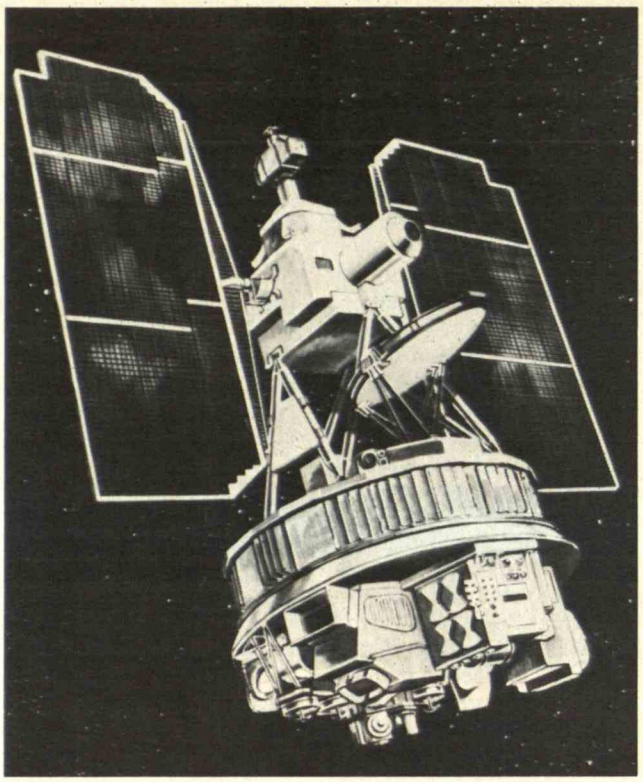
threats to the environment are linked. Declaring that these "global problems require global solutions carried out internationally," NASA administrator James Fletcher said nations must correlate measurements gathered from both space and ground stations.

Endorsing the earth-monitoring ISY goal heartily, the representatives outlined what was termed "a fantastic array" of orbiting instruments expected to be operative by the early 1990s. Among the scheduled ventures that fall roughly under the rubric of this ISY mission is NASA's upper atmosphere research satellite (UARS). Using U.S., British, and French instruments, UARS will attempt to determine the extent and durability of the ozone layer.

Another international venture, the Japanese advanced earth observing satellite—with a proposed 1993 launch date—may carry a U.S.-developed "scatterometer" to measure sea-surface wind speed. And both the European Space Agency's remote-sensing satellite and a French-U.S. mission will provide a wide array of data on ocean circulation patterns and variability.

A New Science?

Despite the number of orbiting instruments, however, prospects for a truly integrated international program by 1992 are slim. One huge obstacle will be organizing the data. Participants attempted to wrestle with the immense problems of collecting, standardizing, and disseminating information for an anticipated database whose size Fletcher estimated would be "literally hundreds of times that of the U.S. Library of Congress." One proposal suggested dividing the data along terrestrial topics such as vegetation patterns, soil moisture, permafrost, sea level, and ocean color to help researchers pinpoint specific environmental changes.



In the 1990s, a new satellite could take over from NIMBUS G, which has supplied data on the ozone layer since 1978.

Many other questions remain, such as how the effort will actually take shape and who will foot the bill. Graham Harris, senior scientist at Australia's space agency, stressed the importance of disseminating the project's collected data widely. He was particularly concerned that Third World countries get access to the information, because they need it to help manage their economic growth. "It's not enough for the information to be fed into a Cray [supercomputer] and stirred," he observed.

Nonetheless, the conference represented a major milestone in cooperation among national space agencies, and it was a step in what Fletcher described as a 50-year task. Conference coordinator Harvey Meyerson, who heads the U.S. International Space Year Association, noted that the meeting was intended "more to stimulate discussion" than to seek instant answers. That conversation was initiated, and participants reached a surprising degree of unanimity about both long-term objectives and immediate goals.

In particular, the conference marked a striking and tacit agreement that space and earth sciences are integrated. A clear consensus emerged that, thanks in part to vast stores of data recorded from space, no single variable of the planet's environment can be understood in isolation. Thomas Malone, an internationally recognized U.S. geophysicist, even went so far as to hail the beginning of "a new science" that aims to illuminate the intimate interaction between the geosphere and the biosphere. □

SETH SHULMAN is a regular contributor to Trends.

Electronics Politics

After a year's delay and despite a continuing controversy between two major industries, one of the latest advances in audio electronics has tenuously reached the U.S. marketplace. Digital audio tape (DAT) systems produce sound on tapes about half the size of conventional cassettes, but with quality comparable to that of compact discs (CDs). The new equipment samples and stores sound using the same basic principles as CDs but employs magnetic tape cartridges rather than optical discs. Initial DAT prices will be high—$2,000 to $4,000—but unlike current home CD players, DAT technology allows users to do their own recording.

DAT's future is uncertain. Its capacity for home taping has been the focus of a year-long conflict between the U.S. recording industry and U.S. and Japanese electronics manufacturers. With announcements of the first DAT machines early in 1987, the Recording Industry Association of America (RIAA) reissued its long-standing complaint that home consumers who duplicate commercial music violate copyrights and rob artists and recording companies of income.

RIAA president Jason Berman took this complaint to Congress last May. He told House and Senate subcommittees that a 1983 study had estimated home taping on standard cassettes had cost his industry $1.5 billion in lost revenues that year—more than one-third its total sales. Attempts since 1982 to par-

PHOTO: NASA

tially compensate for that with a royalty tax on recorders and blank tapes had not been approved.

The RIAA has been aggressive because it believes DAT will exacerbate the problem. Conventional cassettes lose sound quality during the recording process, but DAT can produce generation after generation of virtually identical copies. Testifying before Congress, U.S. Commissioner of Trademarks and Patents Donald J. Quigg agreed that this capability would encourage home taping of copyrighted music.

The RIAA worked with Congress in an effort to pass legislation that would use electronic technology to limit the capability of DAT recorders. The association asked Congress to require DAT manufacturers to add a copy-protection device to all recorders sold in the United States. Developed by CBS Records Technology Center, this "copy-code scanner" would detect an encoded signal in new commercial products—a small band of silence inserted into the audio spectrum—and block attempts to record the material.

The Home Recording Rights Coalition (HRRC), representing U.S. and Japanese electronics firms and a variety of retailers and trade associations, testified against the CBS scheme and the proposed legislation. HRRC attorney Charles Ferris suggested that the RIAA's complaints about revenue losses were numerically incorrect and legally unjustified. He asserted that consumers have a basic right to copy music at home for non-commercial use.

The HRRC also attacked the technical viability of the copy-code scanner. A technical specialist for the coalition argued that the band of silence would noticeably lessen sound quality. A National Bureau of Standards (NBS) study, issued this March, supported that view. The bureau added that the scanner could be circumvented and might occasionally malfunction.

Into the Courts?

The NBS report effectively killed the legislation, but both sides are prepared to continue the conflict in other arenas. When the RIAA began its campaign in 1987, only Japanese firms had announced DAT systems, and these manufacturers honored a request from Rep. James Florio (D-N.J.), chairman of the House Subcommittee on Commerce, Consumer Protection, and Competitiveness, for a moratorium on shipments pending the NBS study. By the time that report appeared, several U.S. firms had announced DAT machines, but they have withheld shipments because the RIAA promises to sue any manufacturer that releases the new system. Japanese suppliers are especially wary of a lawsuit.

In response, the Electronics Industry Association has created a legal fund to defend any member that might face lawsuits over DAT. And the outcome of a suit is unclear. An important precedent may be the 1984 "Betamax" case, in which Universal Studios sued Sony Corp. over the home use of VCRs to copy TV programs. The Supreme Court ruled in favor of Sony, reversing an appellate-court decision that such recording violates copyright laws.

Beyond the legal questions, the technical future of DAT is uncertain. No system is readily available for mass-producing prerecorded DAT tapes, and only a few small labels have released any recordings in DAT format. Moreover, advances in recordable CDs may threaten DAT's commercial appeal, since CDs would be more durable and somewhat easier to program to play chosen selections. Japanese, European, and U.S. firms are all working on this technology for home use.

Because of these problems, only a few DAT machines have reached stores. Early gray-market sales went mainly to customers wanting an easy way to make high-quality live recordings—musicians, recording engineers, and radio stations.

DAT sales may remain largely restricted to this professional market. Several firms, including Kenwood and Alpine, have skirted the home-recording dispute by introducing play-only machines for automobiles. However, very few retailers offer these because their prices are high and few prerecorded tapes are available. Other manufacturers await a resolution of the lawsuit threat. Harmon-Kardon is even reported to have withdrawn its plan to offer a full-capacity home system that it had demonstrated to dealers. □

BRUCE BIMBER, a graduate student in political science at M.I.T., is studying the use of technical expertise in public policymaking.

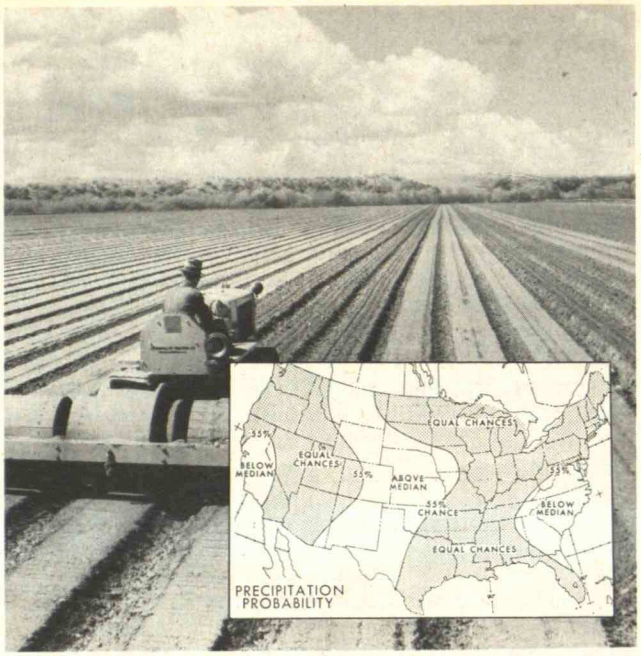




Digital audio tape machines (above) can make home recordings with compact-disc quality.

PHOTOS: HARMAN INTERNATIONAL; GELTZER AND CO., INC.

Weather Skills



It could make good business sense to rely on weather forecasts like this one for July to September 1988.

When humans and intelligent alien life first meet, the climates on their respective planets could be so different as to defy comparison. But the beings will still joke about the universal inability of forecasters to predict the weather.

Despite such jibes, North American weather services are increasingly able to anticipate "skillfully" what will happen in the future. In May, Canada's national weather bureau joined its U.S. counterpart in offering the public a 30-day forecast. While the U.S. Weather Service has been issuing 30-day forecasts since 1947 and 90-day forecasts since 1972, only recently have they qualified these with indications of the skill of the projections. Canada will issue 90-day forecasts within a year, says Amir Shabbar of the Canadian Atmospheric Environment Service in Toronto. The Canadian skill levels were recognized after predictions were analyzed over a three-year period starting in 1985, says Shabbar.

Climatologists studying long-term patterns say their new confidence is not based on any major breakthrough in understanding the high-altitude winds and circulation patterns that create most weather. Rather, incremental advances in computer modeling and collecting historical data have helped scientists revise the concept of "skill" in forecasting. The result could be major economic benefits for certain areas at certain times of the year.

Along with his colleagues, Robert Livezey, chief scientist of the prediction branch of the U.S. Climate Analysis Center in Washington, D.C., has led the way in defining the elements of a "skillful" forecast. He believes unskilled predictions have often hidden behind ambiguous language. He says the *Farmer's Almanac,* which began issuing monthly mean forecasts for 16 U.S. regions in the mid-1970s, is a classic beneficiary of verbal vagueness. The almanac makes its predictions based on a secret formula first derived in 1818. According to editor Ray Geiger, it is partially based on sunspot activity and the position of planets.

In 1981 University of Illinois atmospheric scientists John Walsh and D. Allen analyzed the almanac's predictive ability over a five-year period and found that it was right about half the time. In fact, until recently forecasters had assumed they showed some degree of skill if they were right more than half the time, but Livezey says that record demonstrates "no measurable skill" and actually masks ignorance. He points out that some predictions must be right almost all the time to be useful. For example, a prophecy that the Arizona desert will be dry in July means little. Similarly, most of the world's precipitation occurs in infrequent downpours, so daily predictions of below-average rain incorrectly appear wise.

Meteorologists have also eliminated numerous subtle errors in compiling information that biased previous forecasting efforts. Weather data has often been collected at airports, where "micro-climates" tend to get significantly warmer when houses are built around them. Consequently, predictions of higher-than-normal temperatures could appear right even when they aren't.

Weather Cents

Taking factors like these into account, meteorologists now say that a forecaster in the Arizona case must be right more than 87 percent of the time to be considered skillful. In addition, they have created a new sliding scale—the "skill rate"—that compares predictions to chance guesses. By this standard, a score of 94 percent or higher would mark a skillful forecast.

Climatologists studying long-term trends have also begun to uncover hidden pockets of skill. For example, they have found they have a much better record predicting temperature than precipitation. And they know that predictions of North American temperature patterns in winter have been right more often than those for summers, in part because warm air is less stable than cold air.

Such knowledge has led to analyses showing how relatively small improvements in long-range forecasting—so small as to seem insignificant to outsiders—might have a dramatic impact. Atmospheric scientist Allan Murphy and his associates at Oregon State University in Corvallis have found that dry-land farmers could earn $10 more a hectare if the rainfall forecast around Havre, Mont., were merely a half percent better than chance. Murphy says farmers make decisions about whether to plant spring wheat based on soil-moisture conditions and some feeling about future rain. Forecasts 10 percent better might yield returns of $120 per hectare.

Livezey adds that many potential users of forecasts are unaware of the money to be saved by trusting weather reports. Meteorologists have learned much about where and when predictions are reliable, and although the Great Plains remains a forecaster's nightmare, parts of the Carolinas are much easier to deal with. Large-scale heating-oil consumers there could reap benefits since long-range temperature forecasts are right three-fourths of the time. Livezey suggests that fuel companies could allocate supplies in advance more efficiently if they knew future temperature conditions. □

STEPHEN STRAUSS, a regular contributor to Trends, is a science reporter for the Globe and Mail *in Toronto.*

MAP: NATIONAL WEATHER SERVICE

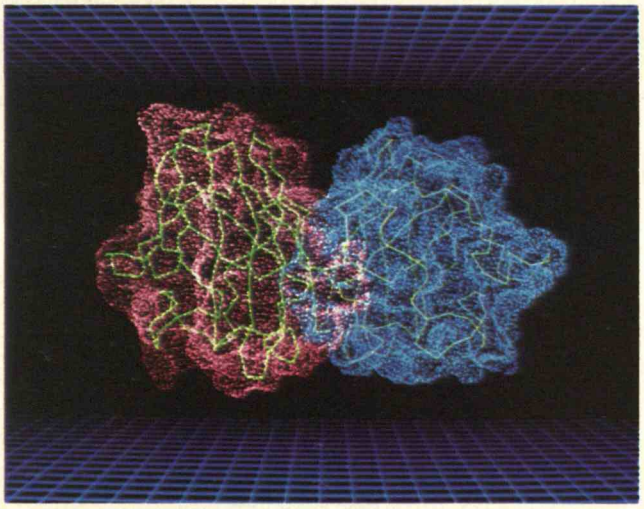
Healthful Scavenger Hunt

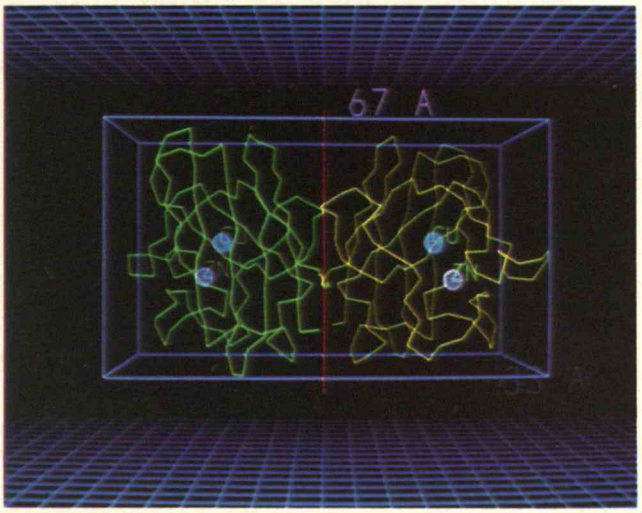
With drugs created by bioengineering enzymes, researchers are combating a chemical that may play a role in arthritis, heart disease, Alzheimer's disease, and many other maladies. Experiments target the highly unstable and lethal "oxygen free radicals"—oxygen molecules that have an extra electron.

Free radicals are common chemistry in the manufacture of rubber and plastics. Polystyrene, for example, results from free-radical processes. The body, too, produces free radicals. When oxygen passes through a cell, enzymes convert it to water, and about one out of a hundred molecules picks up an electron in the process. It comes from the enzymes, which "leak electrons like bad insulation on an electrical wire," says Joe McCord, a biochemist at the University of South Alabama College of Medicine.

Free radicals immediately try to steal an electron from another molecule. When this reaction is controlled, it can help the body. For example, when a white blood cell encounters invading bacteria and viruses, "it kills it by exposing it to a free radical," McCord says. Oxygen radicals also convert food into energy and transfer energy from molecule to molecule.

However, the theft of an electron can set off a damaging chain reaction. Oxygen radicals can attack proteins or nucleic acids, and they have a special fondness for lipids—the fats that make up a cell's outer membrane. Researchers believe that free radicals can transmute nearly all a cell's lipids into toxic lipid peroxides. "It is the same process that causes butter to become rancid," says McCord. Lipid peroxides may further harm nearby cells or disrupt the flow of blood.





Variants on the natural enzyme SOD may help fight many diseases. These computer pictures show SOD's molecular structure.

In healthy tissue, enzymes "scavenge" excess free radicals. Vitamin E can seep into a cell's membrane and remove the odd electron, converting the oxygen radical to water and normal oxygen. Vitamin C will do the same thing and can also help regenerate vitamin E. The body contains other free-radical defenders, including beta-carotene and uric acid.

"The balance between enzymes and radicals is important," says McCord. Traumas such as head injuries or burns can disrupt that balance. "Chemistry is not well managed in unhealthy tissue," McCord notes. There is also growing evidence that radiation and common environmental irritants like air pollutants—carbon monoxide, ozone, cigarette smoke—either contain free radicals or provoke living tissue to create more of them.

Antioxidants to the Rescue

To restore the balance, researchers are looking at a class of chemicals called antioxidants. Chief among these is superoxide dismutase (SOD), which McCord and Irwin Fridovich, his mentor at Duke University, discovered in the late 1960s. An enzyme that occurs naturally in the body, SOD scavenges free radicals and converts them to hydrogen peroxide, which enzymes then break down into water and oxygen.

The California-based company DDI has marketed a variant of SOD called Orgotein in Europe since 1981. DDI developed a process to extract the drug from beef proteins around the same time McCord and Fridovich discovered SOD. Doctors use Orgotein to reduce inflammation in patients suffering from osteoarthritis and rheumatoid arthritis. There is considerable evidence that white blood cells often cause such inflammation when they mistake the body's own cells for invaders and launch a free-radical attack.

Investigators throughout the United States are testing several other permutations of SOD. University of Michigan researchers have treated injured animals—particularly those suffering burns—with SOD, and they have begun hu-

PHOTOS: DRS. ELIZABETH GETZOFF AND JOHN TAINER

man trials on patients with a severe irritation of the lung tissue known as adult respiratory distress syndrome.

Two companies, Bio-Technology General and Chiron, have engineered forms of SOD from yeast or *E. coli* bacteria. Human testing at both firms centers on employing SOD to fight free-radical damage in tissue that is replenished with oxygen—for example, after a transplant. "When oxygen and blood flow return to energy-starved tissue, old enzymes are converted into free radicals," explains McCord.

Chiron vice-president for manufacturing Ron Johnson thinks SOD may soon be coupled with the new heart drug TPA, which unblocks clogged arteries. SOD would protect healthy cells when blood and oxygen flow into the reopened passages.

Even engineered varieties of SOD may not be able to prevent free-radical damage in the brain after a serious head injury or a stroke. The SOD protein is too big to cross the protective cell layer around the brain. So Upjohn scientists have developed drugs they call lazeroids—after the biblical character who rose from the dead. Made of fat-soluble steroids and scavenging molecules, lazeroids can seep through a cell's lipids.

As the connections between free radicals and disease grow, so do possible applications for antioxidants. Some researchers have suggested that free-radical scavengers might dampen the progress of such diseases as Parkinson's or some cancers. And antioxidants could help prevent the free-radical damage that accompanies radiation therapy. □

TOM KIELY is a frequent contributor to Trends.

MINI · TRENDS

SCIENTIFIC OATH

An international conference held in Buenos Aires has yielded a Hippocratic oath for scientists. At the meeting on scientists, disarmament, and peace, Argentine astrophysicist Guillermo LeMarchand urged the endorsement of a pledge that would "ethically bind people upon graduation" to apply their knowledge "only for the benefit of mankind." Graduating students traditionally swear a professional oath in Latin America. Argentinians even swear to support the "fatherland."

In the Buenos Aires oath, students would pledge to exercise their training "solely on my personal belief and social responsibility . . . that the scientific or technical research I undertake is truly in the best interests of society and peace." They would also express the intent never to use their abilities "merely for remuneration or prestige or on instruction of employers or political leaders only."



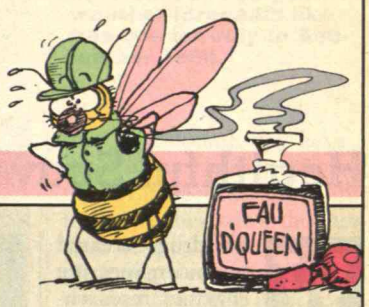
APARTHEID URANIUM

In 1986, Congress enacted the Comprehensive Anti-Apartheid Act, banning imports of "uranium ore [and] uranium oxide . . . produced or manufactured in South Africa." However, the Nuclear Regulatory Commission (NRC) and the Treasury Department argue that the law allows firms to import uranium oxide that has been transformed into uranium hexafluoride. They also have announced their intention to permit imports of ore and oxide that will be processed for re-export.

Based on this argument, thousands of tons of South African uranium could be imported under applications already filed. But several members of Congress, a South African exile, an unemployed U.S. uranium miner, and a number of U.S. anti-apartheid organizations have gone to court to block the agency's interpretation of the law. The court ruling will hinge on the "substantial transformation" doctrine—the extent to which processing changes the value of ore.

THE ROYAL SECRET

Researchers have uncovered what makes a queen. They have identified the chemical mix that honeybees produce to control the social fabric of the colony. This could lead to new tactics for increasing crop yields and for countering Africanized "killer" bees as they advance north. "It is the final piece we needed for completing a long-standing puzzle," Keith Slessor of Simon Fraser University told the Third Chemical Congress of North America.



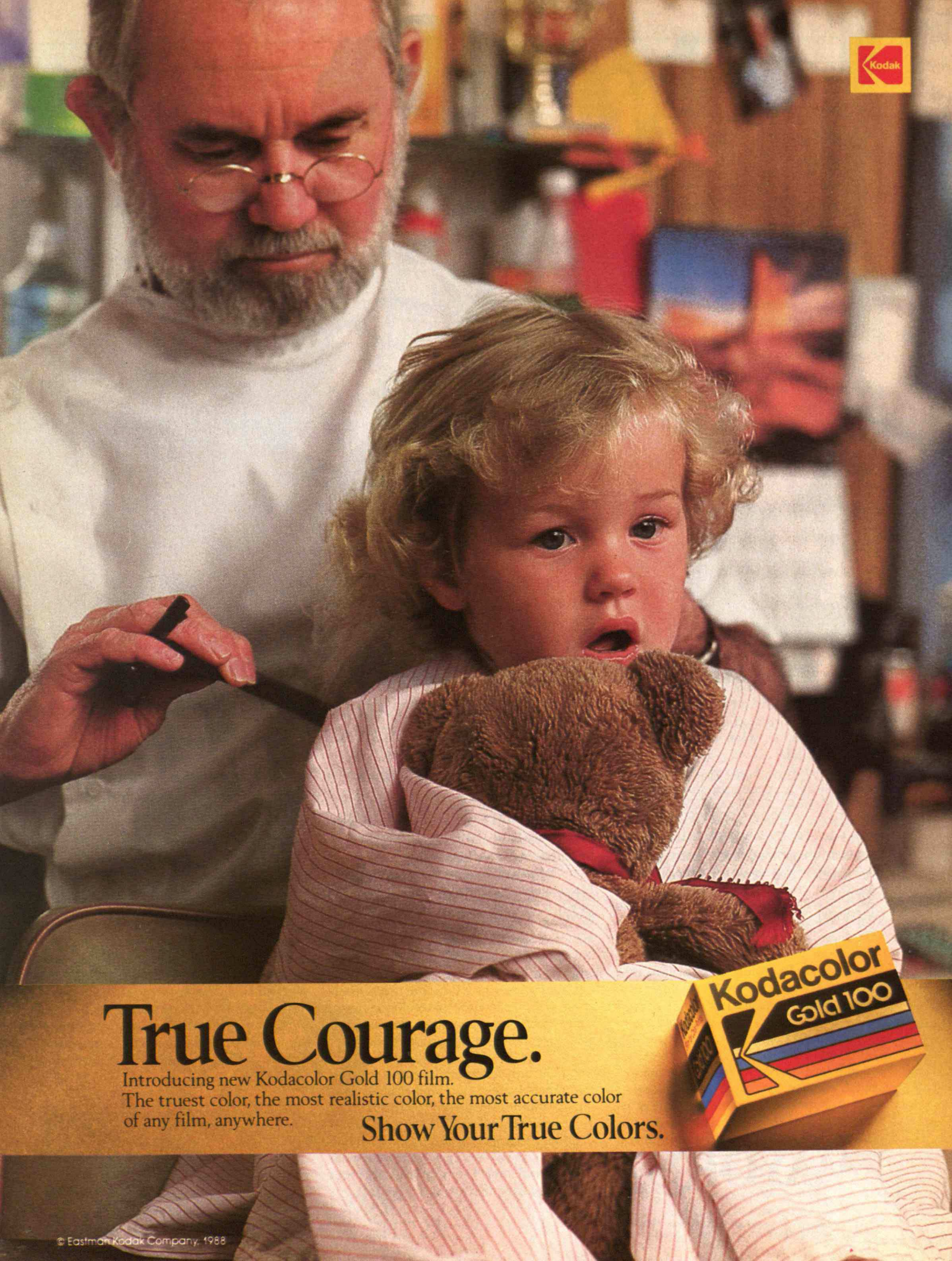
Researchers have known for years that worker bees lick and rub against the queen close to a gland she has that produces a variety of pheromones, or signal chemicals. The worker bees receive minute amounts of various queen substances, which control their overall behavior. Slessor and his colleagues have concocted a brew of five queen-bee substances that elicits the same behavior even when no queen is present.

FALL FOR SAFETY

Volunteers at the Georgia Institute of Technology are falling for safety. School of Architecture researchers John Templer and Deborah Hyde hope to design stairs that might prevent some of the 1.8 million stair-related injuries that occur each year. The work focuses on "what happens in that quarter second during the fall and how people really get injured," says Hyde.

Volunteers receive $15 to don a flight suit and safety padding, step into a modified parachute harness, and walk up and down specially built stairs. At random intervals, researchers collapse one stair. Elaborate safety mechanisms catch the falling volunteer—but not before high-speed cameras preserve the action.

Hyde compares the project to crash-testing to improve automobile safety. One result may be "soft stairs"—padded like basketball goals—that people could hit without being hurt.



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LANGDON WINNER

The Machine in the Nursery

Walking down the aisle of a toy store recently, I was reminded of a passage from Plato's *Laws*. "If you control the way children play," the philosopher wrote, ". . . you'll find that the conventions of adult life . . . are left in peace without alteration." Plato was referring to the way the games and objects of children's play shape the conditions and expectations of adult life. Toys reveal one generation's ideas about the way the world is and ought to be, even as they contribute to another's.

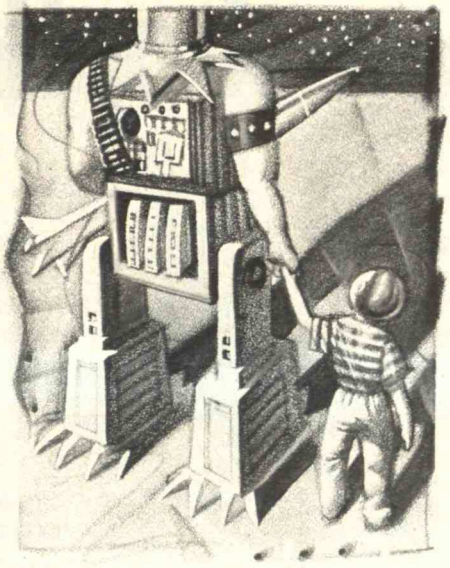
What brought Plato's observation to mind was the discovery that my own ideas about the representation of the human form in toys are hopelessly out of date. I was looking for a simple plaything for my three-year-old son—a little cowboy, circus clown, farmer in the dell, or something of the sort. What I found instead were "action figures"—odd composites, half man, half creature from outer space; superhuman warriors in the style of Rambo or G.I. Joe, with exaggerated muscles and weapons at the ready; and robots with mechanical and electronic protuberances.

In frustration, I asked a clerk, "Do you have any action figures that look more or less human?" He showed me a rack of toys in a far corner of the store, labeled "Discontinued Items—Marked Down." There I found a handsome plastic astronaut, the last remnant of a product line that had long since gone out of fashion.

My surprise at the appearance of the modern, high-tech gadgets led me to take a closer look. If, as Plato suggests, our playthings are harbingers of the future, what kind of world do today's toys anticipate?

Meet Monsterbot Repugnus

One distinguishing characteristic of contemporary toys is that nothing is ever quite what it seems. It used to be that a truck was simply a truck, an airplane simply an airplane, a dinosaur simply a dinosaur. Well, you can forget that. Today's toys made of brightly colored, intricately molded plastic undergo rapid transformations. With several twists of the wrist, an object becomes something entirely different from the item you held in your hand a moment ago—a space ship or robot warrior or a dragon from a distant planet.



Today's high-tech toys present a chilling image of the future.

Toys of this kind are a wonder to behold: clever in conception, elaborate in design, surprisingly durable given the large number of tiny joints and connections they contain. The most popular ones are Transformers, a line created by the Takara Corp. in Japan and sold by Hasbro-Bradley in the United States. Following a marketing strategy now common in the toy industry, Transformers are also the stars of a television cartoon series. Each Saturday morning, millions of children watch events unfold in a universe of rock and metal, populated by dozens of transforming robots in various shapes, sizes, and dramatic roles, all of them engaged in never-ceasing high-tech combat.

These cartoon characters and their toy-store replicas have names like Headmaster Skullcruncher, Pretenders Autobot Chainclaw, Decepticon Clone Pounce Wingspan, and the leader of the good guys—insofar as there are any good guys—Powermaster Autobot Leader Optimus Prime. Interestingly enough, each Transformer package carries a psychological profile describing the strengths and foibles of the robot inside. Monsterbot Repugnus, for instance, "has a personality as repellent as his looks—been kicked out of the Autobots many times for insubordination only to be asked back since he's always willing to undertake missions too low-down and dirty for anyone else to consider. In robot mode, carries venom laser that slows cerebro impulses and paralyzes on impact."

Clearly, we've come a long way from *The Little Engine That Could.*

Celebrating Constant Change

At one level, the violence of these toys and fantasies is not particularly distressing. As psychoanalyst Bruno Bettleheim has noted, grotesque themes provide a way for kids to come to grips with many of the unconscious fears of childhood. *Grimm's Fairy Tales,* for example, is full of monsters, blood, and gore. In a similar way, the Transformers may allow children to confront and even have fun with important issues about growing up: power, control, creation versus destruction, and the distinctions between love and hate, good and evil.

However, there are important ways in which today's toys are not at all like traditional dolls and fairy stories. They do not give children a good way to handle the negative emotions they evoke. And they consistently portray modern technology in a disturbing role, emphasizing its most dangerous, destructive aspects. Is this the human future we want to present to our children?

For instance, the high-tech arms race is the sine qua non of the brave new world of toys, and everyone's involvement in it is depicted as life's highest calling. It is not only the atmosphere of violence that is distressing here; after all, imaginary violence is a familiar part of old-fashioned games like cowboys and Indians. But in current toys, violence has become linked to technological virtuosity—as if the only purpose of technical creativity were to destroy one's enemies and dominate in conflict.

These toys also celebrate a completely automated, non-human world. The Transformers don't just have technology; they *are* technology. And robots are regularly depicted as stronger, smarter, and more interesting than normal people. The tacit assumption seems to be that it is unnecessary to put up with deficiencies in human character and human relationships when the

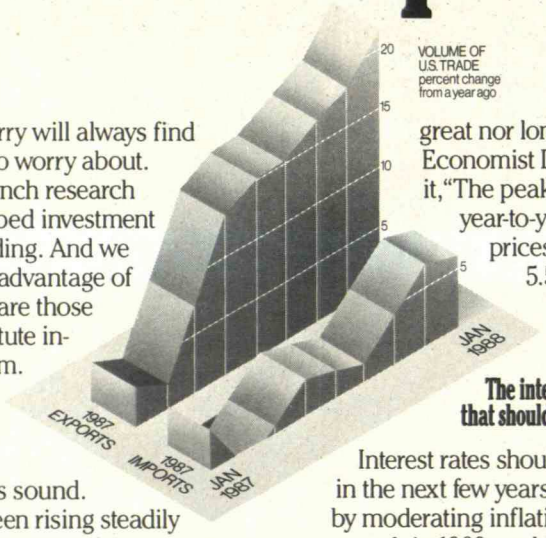
Continued on page 78



LANGDON WINNER TEACHES IN THE PROGRAM ON SCIENCE AND TECHNOLOGY STUDIES AT RENNSELAER POLYTECHNIC INSTITUTE. HIS MOST RECENT BOOK IS THE WHALE AND THE REACTOR.

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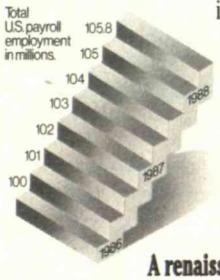
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Valid but Exaggerated Concerns

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We also see emerging opportunities in selected high-yielding stocks such as those of utilities and insurance companies. And, as Merrill Lynch Chief Investment Strategist Charles I. Clough points out, "Foreign investment flows into dollar-denominated financial assets are likely to be increasingly supportive of the U.S. financial markets."

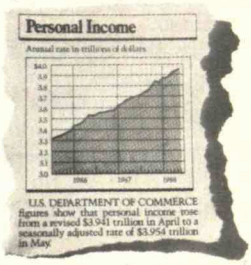
Inflation is up. But not severely.

While the drought in the Midwest is boosting food prices, the overall effect should be neither great nor long-lasting. As our Chief Economist Don Straszheim puts it, "The peak inflation rate, based on year-to-year changes in consumer prices, is likely to be about 5.5%, far below the 14.5% peak in the second quarter of 1980."

The interest rate outlook: something that should make everyone feel optimistic.

Interest rates should decline substantially in the next few years. This would be spurred by moderating inflation, slower economic growth in 1989, and a rising surplus in the Social Security trust fund, which will make the government a bigger customer for its own debt, reducing the amount it must raise from the public.

This means that U.S. Treasury bonds and high-quality corporate and municipal bonds—which are now paying healthy interest rates—are also likely to increase considerably in value.


Personal Income

Annual rate in trillions of dollars

$4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0

1986 1987 1988

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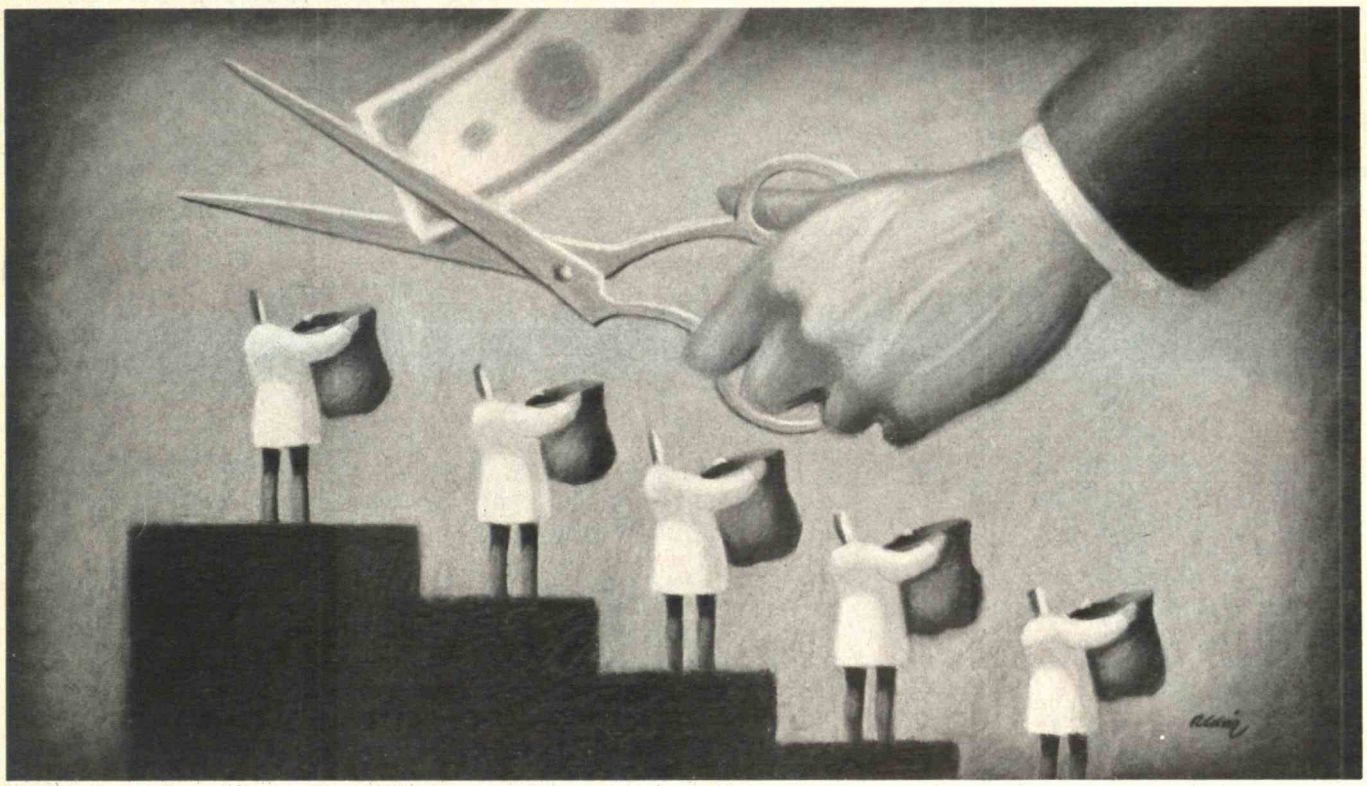
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BY FRANK H.T. RHODES

A System to Set Science Priorities



THE late Sen. Everett Dirkson's famous comment on the federal budget process—"a billion here, a billion there, and pretty soon you're talking about real money"—has taken on new meaning when it comes to federal funding for science and technology. The government spends $62 billion a year in this area. But there are simply more worthy research ideas, many with multibillion-dollar price tags, than the nation can support on this limited budget. Now competing for funds are such "big ticket" items as upgrading obsolescent research laboratories (which would cost as much as $20 billion), the space station (at least $16 billion), the superconducting supercollider ($4.4 billion), and a project to map the human genome ($3 billion).

As a matter of fiscal necessity, the government will have to choose among such projects. What is sorely needed is a coherent, rational system for doing so.

The general problem of setting priorities has been widely discussed this year, and the White House and Congress have asked the National Academy of Sciences (NAS) for advice on the issue. But the actual mechanism for rating science and technology proposals remains a subject of considerable debate.

Together, experts, Congress, and the president's science advisor could impose order on federal research funding.

Last August, as chairman of a three-person National Science Board (NSB) working group, I proposed a tripartite system that could help determine the nation's science and technology priorities. The proposal, which in September awaited review by members of the NSB—the group that oversees the National Science Foundation—calls for recommendations to come from a committee representing the scientific community, a congressional committee that would oversee the many proposals coming before the legislative branch, and a presidential science advisor who would have a say at cabinet meetings.

The system would coordinate the concerns of the players interested in federal science and technology funding—the public, Congress, and the executive branch of government. Yet it would divide these groups' authority, so no player could influence the process unduly. It would thus provide the president and Congress with authoritative and balanced advice—a much better approach than the ad hoc one we rely on today.

Today's Fragmented System

The current process is anything but orderly. Proposals for science and technology projects may originate with as many as 15 federal agencies and departments and be reviewed by 6 divisions of the congressional Office of Management and Budget.

FRANK H.T. RHODES is president of Cornell University. He serves on the National Science Board and the University Forum of the Department of Defense.

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The president's science advisor may review the proposals and suggest certain priorities in science and technology. As the post is currently construed, however, the advisor has relatively little influence with the president or cabinet members. These officeholders may or may not ask for the science advisor's input on particular ideas. Therefore, the science advisor has little control over which projects eventually receive presidential endorsement.

At the congressional level, more than 100 committees and subcommittees have responsibility for proposals concerning science and technology. Nine appropriations committees, as well as several other budget and authorization committees in Congress, also have a say. While the efforts of so many groups may lead to favorable treatment of science at times, they represent an incredible cost in terms of staff and work.

And there is little assurance that the best projects will receive funding. Under such conditions, Congress can earmark agency budgets to fund pork barrel projects, without serious regard to the merit of a proposal or an institution's suitability for undertaking the work.

The fragmentation in the U.S. method for choosing science and technology priorities cannot be done away with by simply adopting the highly centralized approaches that most other developed countries use for making such decisions. The United States is too committed to a division of authority within government. But the three-pronged approach suggested by the NSB group could work.

Input from Scientists and Engineers

How would a tripartite system function? First, the NSB would appoint a standing advisory commission on science and technological priorities. The commission, which would report to the NSB, might include three members nominated by the board, and one member each from industry, academe, the military, and the National Academies of Science and Engineering and the Institute of Medicine. Members would be chosen for the breadth of their knowledge and experience in science and science-policy matters.

While the NSB has the breadth of experience and knowledge to do the job itself, it is already occupied with the responsibilities of disbursing nearly $2 billion a year in NSF research funds, and with overseeing such major programs as the engineering research centers. An NSB-appointed commission, however, would have time to solicit the opinions and insights of all the major players in the science and technology arena, including members of the public and science-watchdog groups.

In fact, I would suggest that one of its first jobs in establishing science and technology priorities should be to consult with public-interest groups. As a starting point, the commission could evaluate the guidelines suggested by NAS President Frank Press this past April. Press suggested that the highest priority be given to fellowships and other grants that reach the greatest number of scientists, engineers, and clinical researchers. This would ensure that the work of creative individual investigators would continue to flourish in a host of fields, and would help maintain the balance in the national research agenda with "big science" projects.

Also high on Press's list is research that responds to major national crises such as AIDS, and that continues work in areas of extraordinary promise such as high-temperature superconductivity. Other expensive, long-term projects such as the superconducting supercollider should be ranked a notch below. Funding for them could be delayed until the federal deficit is brought under control. And Press proposes that "glamour" projects such as the space station receive the lowest funding priority.

The second pillar of the tripartite system is the presidential science advisory position. That job should be recast into one of real influence within the executive branch, as has been proposed by Press, M.I.T. President Emeritus Jerome Wiesner, and others. Because of the absence of a full-scale department to administer, difficulties might arise in making the science advisor a true cabinet-level position. But the important issue is not one of title but of access to the highest levels of national decision making.

We need a person within the executive branch, perhaps called a "special assistant to the president for science and technology," who can attend cabinet meetings. This person could offer informed advice to the president and cabinet members whenever an issue with a science or technology component is discussed in the White House.

Continued on page 25



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CONTINUED FROM PAGE 22

The special assistant could draw upon the reports of the National Science Board commission as needed, and could solicit comments and recommendations from the group on specific proposals.

One Committee Instead of 100

The third pillar of the plan would be supplied by Congress. The House and the Senate should form a joint coordinating committee to expedite the congressional deliberations in science and technology policy. The group's size and membership would be worked out by Congress.

The committee also would have access to reports developed by the NSB commission, and could request that the group recommend action on specific issues or review specific funding requests. Drawing on the commission and other sources, the congressional committee could make better-informed decisions on funding priorities than is now the case.

The formation of a joint coordinating committee would not eliminate lobbying by advocacy groups or others interested in advancing their own agendas. But in most cases at least, given its broad base, the committee would be knowledgeable enough to weigh the validity of individual lobbyists' requests.

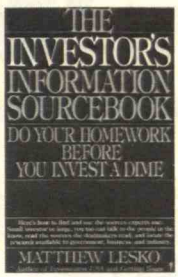
The committee's recommendations would provide Congress as a whole with informed advice upon which to base a national science and technology funding plan. And the committee would bring a focus to the issues much like the Joint Economic Committee does with economic matters today. In putting together each year's spending bill, Congress could then balance science and technology priorities against other national needs such as deficit reduction or social-welfare programs.

The tripartite system for rational decision making in science and technology would not diminish the present prerogatives of the executive and legislative branches of government. The president would still propose, and Congress would still dispose. And public input—to the NSB commission and executive and legislative branches of government—would remain critical.

As the reigns of state are handed over to a new president, we in the nation's science and technology establishment must quickly agree on the need to set priorities that serve national goals rather than narrow self-interest. And we must convince the president and congressional leaders of the value of a coordinated decision-making process. Given the growing influence of science and technology in Americans' daily lives, such efforts would be no trivial contribution. □

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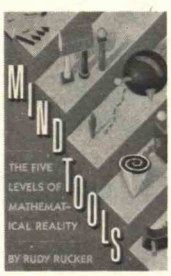
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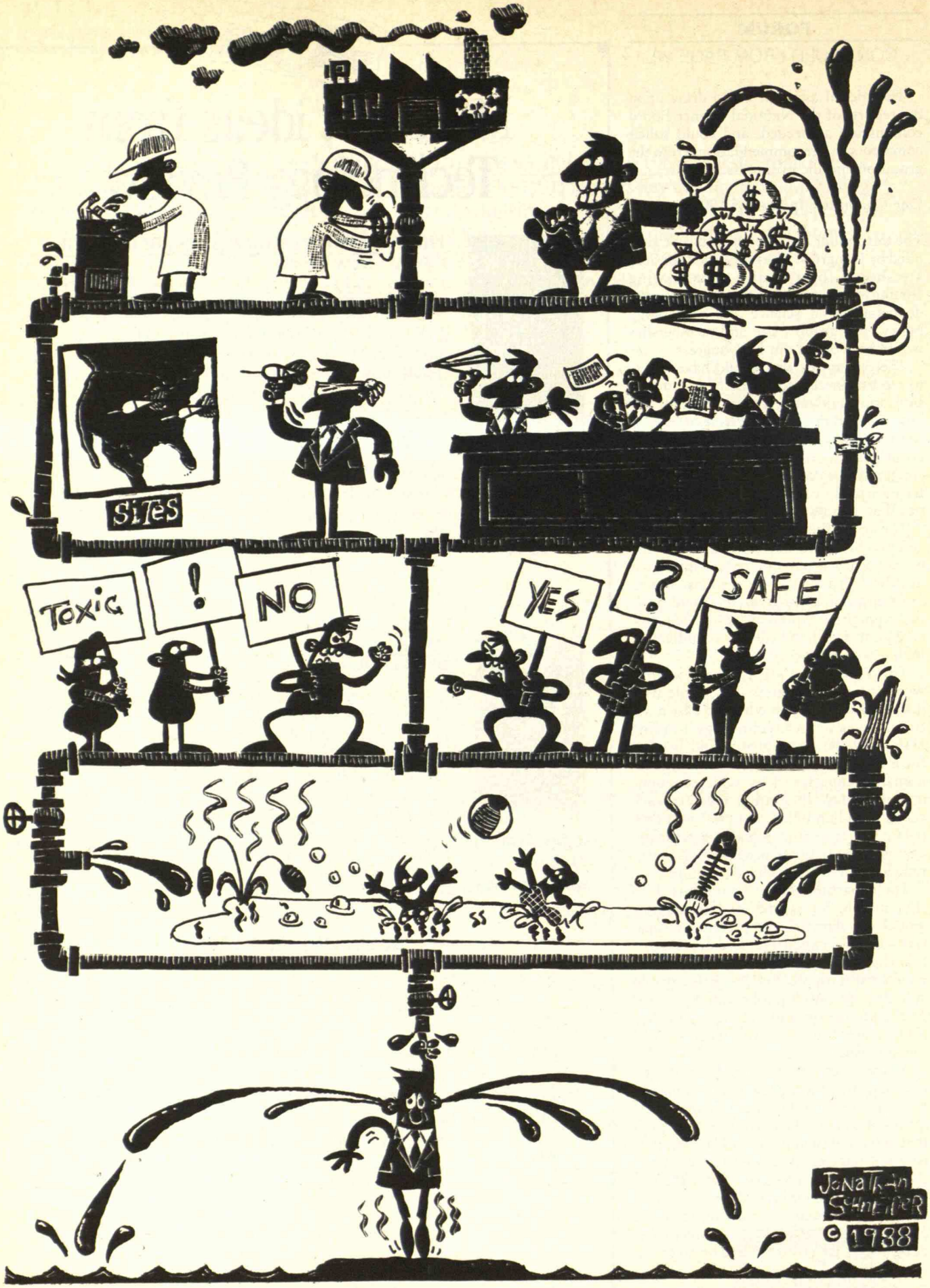
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Superfund
Still in the Dumps

BY JULIE L. EDELSON

THE U.S. Environmental Protection Agency is trying to make Ohio's Pristine toxic-waste site live up to its name. Unfortunately, EPA's choice of cleanup method for the Superfund site has generated bad chemistry among the parties concerned. The treatment, in-situ vitrification, consists of zapping soil with high voltages of electricity until some organic contaminants vaporize and the soil melts around other wastes to form a lava-like mixture that eventually hardens.

Almost nobody is satisfied with EPA's decision. One reason is that in-situ vitrification is unproven; it has never been used at a Superfund site, and has only recently started undergoing lab tests. The congressional Office of Technology Assessment (OTA) has concluded that the procedure might release harmful emissions into the air and leave some chemicals untreated, and that the glassy substance it produces might crack and introduce new contamination. An OTA report issued this past summer recommends incineration, which an EPA contractor says would do a better job of reducing contamination but would be more expensive. The district's Democratic congressman, Thomas Luken, plans to probe the agency's reasons for selecting in-situ vitrification.

Another issue is money. The polluters want a cheaper treatment that uses a vacuum to suck the hazardous wastes from the ground. The city of Reading, Ohio, where the waste is located, also prefers a less expensive cleanup, and wants EPA to hand over the remaining funds so the community can build a new municipal-waste treatment plant. (EPA is uncertain whether it would be authorized to do so.) The only governmental body backing EPA's position is the state of Ohio.

Such controversy has become the norm in the selection of cleanup plans for sites in the Superfund program, which President Carter signed into law in 1980. Congress designed the $1.6 billion toxic-waste cleanup program to be administered by EPA and funded primarily by polluters. Not all the polluters were directly responsible for the contamination (many had entrusted their wastes to disposal companies), and Congress anticipated some resistance. If polluters refused to pay, EPA was encouraged to fund the cleanups and sue for reimbursement.

Despite bipartisan congressional support, the program has had many problems. Certainly one reason is the number of parties involved in the site cleanup decisions. First EPA determines whether a hazardous-waste site poses enough danger to warrant inclusion on Superfund's national prior-

Despite stronger legislation, the nation's hazardous-waste cleanup program continues to struggle.

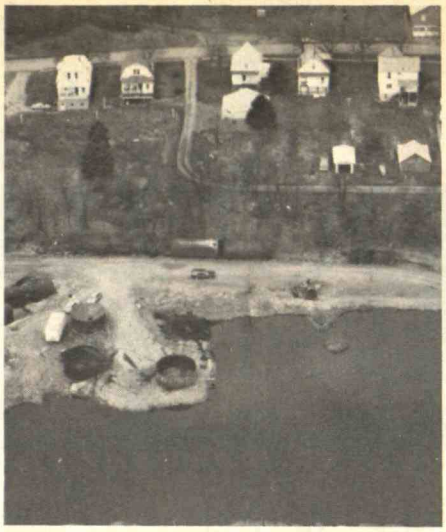
ities list. If so, either the agency or any polluters who agree to help pay for treatment evaluate the alternative cleanup methods. Then the public gets up to two months to comment on EPA's "record of decision," the document explaining the agency's preference for a certain treatment technology. At this point, the community, environmentalists, industries, and congressional members can get involved. After comments are received, the agency or polluters design the specific steps of a cleanup and arrange for the work.

Given the complexities, costs, and fears associated with toxic-waste treatment, clashes between interest groups are inevitable—making it difficult for the agency to choose a satisfactory technology. "We can't win," laments Priscilla Flattery, Superfund program spokeswoman.

But EPA has not helped matters. It often enforces the Superfund laws inadequately, authorizes the use of questionable treatment methods, and fails to get all the polluters of a site to fund a cleanup. In addition, EPA has yet to resolve basic management problems that have plagued Superfund from the start. EPA headquarters leaves most of the decisions to its regional offices, which are all subject to different political pressures. As a result, the quality of site cleanups varies from region to region. And because of high job turnover, the agency often relies on contractors and inexperienced staffers to manage major cleanup projects.

Cleaning up Superfund

The original Superfund program was mired in political scandal. EPA Administrator Anne Burford and Superfund director Rita Lavelle earned notoriety with their efforts to minimize the program's scope and its effects on industry. During their tenures, only six cleanups were completed. And EPA's typical approach to treating a site was simply to cap contaminated wastes with clay, soil, or plastic and leave them in place, or else dispose of the material in landfills. This left open the possibility that the wastes might leach out and contaminate more soil and groundwater.



The EPA must decide whether to use Superfund to clean fewer sites completely or more sites less fully.

In 1986 a mistrustful Congress responded by passing a far more prescriptive statute, the Superfund Amendments and Reauthorization Act (SARA). Congress authorized $8.5 billion for five years for a program revised to avoid the failures of Superfund's early years. The new act pressed for stronger cleanup measures that would destroy waste permanently, whenever possible. It also encouraged more public oversight of EPA by setting up technical-assistance grants for citizens seeking to study EPA's cleanup alternatives.

To speed the treatments, SARA established an extensive list of deadlines for studying Superfund sites and starting cleanups. It mandated that EPA finish reviews by 1990 of the more than 27,000 sites that are Superfund candidates, and by 1991 start preliminary studies at 650 sites—and treatments at 375.

EPA has had mixed success in meeting its deadlines. Two of the five years allotted for starting cleanups have now passed, and the agency has started treating just 55 of the Superfund sites, which have now grown in number to 1,077. But the agency has already begun 156 studies on cleanup alternatives for Superfund sites, and expects to commence with some 275 required studies by October 1989. It also expects to meet a January 1989 deadline requiring preliminary assessments at all Superfund sites.

Focusing on the numbers may obscure more important matters, however. Environmentalists and some congressional aides have accused EPA of ignoring SARA's preference for thorough cleanups. They fear that Superfund sites will be plagued by recurring waste problems.

How Clean Is Clean?

Under SARA, EPA must decide on a critical matter—the extent to which hazardous-waste sites are to be cleaned. Though the law called for "permanent" cleanups and set extensive demands, EPA's resources are finite. The agency has been forced to decide whether it should use its money to clean a relatively small number of sites completely, or more sites less fully.

EPA is supposed to answer that question in a detailed document known as the National Contingency Plan (NCP). But internal battles over defining cleanup standards have prevented the document from being issued by SARA's April 1988 deadline. EPA will not issue a final plan for at least another year. So far it has only set a broad range of allowable risk after site cleanup—between 1 related cancer death a year per 10,000 people and 1 per 10 million people.

Unofficially, the agency has demonstrated a preference for distributing resources over more sites. In fiscal 1987, according to congressional testimony from OTA's Joel Hirschhorn, about two-fifths of EPA's cleanups used the inexpensive method of containing waste in landfills; only about one-fifth of the time did the agency destroy the toxins, as mandated by SARA. (Hirschhorn says the remaining treatments simply transferred the contaminants from one medium to another—from water to air, for example.)

EPA's tendency toward less thorough treatment options has raised the

PHOTO: STEVE DELANEY

hackles of both government officials and private citizens. In 1986, for example, the agency was faced with removing PCBs and volatile organic compounds from soil and a drinking-water supply at the Ottati & Goss/Great Lakes Container Corp. toxic-waste site in Kingston, N.H. Instead of trying to eliminate the carcinogens completely, EPA opted for more easily attainable groundwater cleanup levels. It has since used the case as a precedent for cleaning groundwater at most other sites.

Although some congressional members (notably Democratic vice-presidential candidate Lloyd Bentsen) believe that SARA gives EPA the flexibility to opt for less thorough groundwater cleanups, others believe the agency has misinterpreted the law. Senators George Mitchell (D-Maine), Frank Lautenberg (D-N.J.), Robert Stafford (R-Vt.), and Dave Durenberger (R-Minn.)—all of whom serve on the Environment and Public Works Committee—say that EPA's standards are not stringent enough. The agency's stance also angers attorney Rena Steinzor, who wrote major portions of SARA. She criticizes EPA for failing to consult with Congress.

Opposition also erupted when EPA selected a bargain-basement treatment plan for a toxic-waste site near the airport in Crystal City, Tex. The $1.6 million plan consists of creating a landfill on site by consolidating soil laced with DDT, arsenic, and other contaminants, and then capping the site. The waste will be near a housing project and two schools as well as above a groundwater reserve. The agency is resisting calls by citizens and the local congressman, Democrat Albert Bustamante, to consider more thorough remedies. It has turned down citizens' requests for an extra $500,000 to give the landfill a double lining. EPA says the contaminants are unlikely to leach through the soil, and that incineration—which the OTA report suggests instead—would be costly, would not destroy the arsenic, and would require closing the airport for at least two years.

Some observers suspect that EPA will try to institutionalize the less-is-better approach by writing vague cleanup standards into the NCP. Philip Cummings, a lawyer who wrote major portions of SARA, says drafts he has seen of the plan leave maximum discretion for cleanup standards to EPA site managers. Even some agency insiders are worried. Many attorneys at EPA headquarters fear that if weak standards are adopted at some Superfund sites, industry will push for similar standards elsewhere. Moreover, the lawyers say, if the NCP's language is ambiguous, EPA decisions will not stand up to scrutiny in the courts.



Unofficially, EPA has shown a preference for distributing its funds over more sites.

An "early-action" provision in the NCP drafts also has many people worried. This provision would let EPA start a cleanup before receiving public comment and finishing deliberations on the best treatment for a site. J. Winston Porter, EPA's assistant administrator for Superfund and solid waste, says he developed the early-action approach to get more cleanups under way. Philip Angell, one of many industry representatives supporting the plan, says industry would prefer to start treating wastes sooner to prevent contaminants from migrating and thereby necessitating more extensive, costly cleanups.

But some environmentalists and EPA staffers, as well as congressional aides who drafted SARA, charge that the plan would contradict SARA's goals by not involving the public and by promoting partial cleanups. And 6 of the 10 EPA regional administrators oppose the idea on the grounds that they already have the authority to clean part of a site early if they choose.

"This is a hit-and-run plan," says Henry Cole, science director of the Clean Water Action Project, an environmental organization. Cole worries that EPA will not return to a site once it takes preliminary measures, or that by starting too many cleanups it will run out of money before it can finish them.

Who's Running the Show?

In addition to the controversy over cleanup guidelines, EPA's management of Superfund has come under fire because of the agency's focus on regional decision making. Superfund director Porter has taken a hands-off attitude toward the 10 regional EPA offices, emphasizing what he calls a philosophy of "flexibility." He says that because each Superfund site is unique, he cannot exercise a "cookbook" approach to cleanups from the "academic world" of Washington, D.C.

The OTA report counters that Porter's weak central management has created "a loose assembly of disparate working parts." The report asserts that "uniqueness has been carried to an extreme and has blocked understanding of common site characteristics, common cleanup problems, common solutions, and common experiences with site studies and decisions."

Porter's approach simply doesn't work, says Gene Lucero, who until June directed EPA's Office of Waste Program Enforcement. "Most regions are interpreting the statutes themselves, and are not getting clear signals as to what the objectives should be." Samuel L. Silverman, EPA's acting deputy director of waste management for New England, says he needs more direction on how quickly sites should be cleaned, how much soil should be

PHOTO: O. FRANKEN/SYGMA

treated, and how much information is necessary before groundwater can be treated.

The lack of guidance can produce wide discrepancies in the standards set by different regional offices. *Right Train, Wrong Track*, a report published by an unusual combination of environmental and industry interests this past summer, offers an example. The EPA office overseeing a cleanup in Rose Township, Mich., decided that an acceptable level of lead in the soil would be 70 parts per million. Without direction from headquarters, the office assumed that children under three—who can suffer developmental problems from eating lead-laced soil—would be supervised and would thus stay away from contaminated soil areas. Meanwhile, the regional office in charge of a dump site in Harrison, Wis., estimated that a child consumes one gram of soil a day. To be on the safe side, it decided on lead levels of 14 parts per million—one-fifth as high as in Michigan.

The emphasis on regional decision making has also resulted in inconsistent choices of treatment technologies. A treatment method called solidification, which binds wastes to lime or cement, was rejected for a site in Massachusetts. EPA's regional office there decided that the process does not do a good enough job of chemically fixing organic contaminants. But under pressure from industry and from residents who feared incineration, the regional office overseeing a Superfund site with organic chemicals in Sand Springs, Okla., succumbed to testing solidification and burying the product on site. (It did maintain the option to require incineration should solidification fail.)

This case is one of EPA's 10 worst Superfund decisions, according to *Right Train, Wrong Track*, which looks at EPA's cleanup choices for Superfund sites since SARA. The report concludes that because the site is on a river and has a history of submersion during heavy rains, contaminants buried there could spread.

Inconsistency in treatment technologies and cleanup levels nationwide is exacerbated by EPA staffing problems. Many Superfund employees have left because of the lure of better-paid jobs in the private sector. As a result, multimillion-dollar cleanup projects often end up in the hands of young, inexperienced agency staffers. For the EPA region that includes New York and New Jersey—states with some of the worst Superfund sites—two-thirds of the Superfund enforcement attorneys have been at EPA less than two years, according to Walter Mugdan, deputy regional counsel.



The EPA's regional offices can differ widely on cleanup standards. In some cases, treatment choices have been inconsistent.

Porter attempts to fill the experience gap by hiring private contractors, but here again there is no guarantee that their work will be satisfactory. Assessing different Superfund sites with similar pollutants and environmental conditions, separate offices of a single EPA contractor may arrive at substantially different per-cubic-yard incineration costs, according to OTA's report. That, in turn, can influence EPA's choice of cleanup technologies. It did with the Pristine dump, where a contractor estimated that incineration would cost $730 per cubic yard—or $51 million—while in-situ vitrification was estimated at $22 million. For similar dumps elsewhere the same contractor gave incineration estimates ranging from $186 to $349 per cubic yard. At these rates, incineration at the Pristine site would have totaled $13 million to $24 million—competitive with the method chosen.

EPA's reliance on contractors "is a horror show," says Edmund Frost, an industry attorney who has participated in some of the most complex, contentious Superfund litigation. "If we are going to be governed, we want to be governed by someone in the U.S. [government]," not contractors.

Making Polluters Pay

While many of EPA's problems stem from inadequate cleanup standards and inconsistent treatment measures, the agency also has to do a better job of arranging for payments from polluters, says Rep. John Dingell (D-Mich.). EPA is often reluctant to accept offers by polluters to pay their portions of the costs of a cleanup. The agency fears reliving Superfund's early history, when the agency was criticized for making sweetheart deals with industry. Instead, EPA attempts to gain the full cost of treatment from major polluters with "deep pockets," hoping that these companies will in turn sue the other liable parties. Thus, many polluters are scared to make offers, says John Quarles, an industry lawyer and former EPA deputy administrator—and the agency often ends up using federal dollars to conduct cleanups.

This approach is fast draining Superfund's coffers. Based on average cleanup cost estimates, the House Appropriations Committee reported earlier this year that the total federal funding required for treatments could be as much as $23.8 billion—far more than the money authorized for Superfund.

EPA would spur more polluters into paying by providing more incentives to settle, Quarles says. He believes some polluters are anxious to pay because they don't want to tarnish their corporate image further, or to risk additional damage to sites and higher cleanup costs. If some wastes were dumped by a party that is unknown or now bankrupt, he says, EPA should use Superfund to finance that portion

PHOTO: EPA

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of the cleanup, as SARA authorizes. That way the parties wouldn't have to haggle endlessly over who should pay the orphan share.

Of course, this approach might encourage more companies to hide in the crowd. But EPA could discourage such conduct by prosecuting the nonsettlors in these cases. In April, EPA responded to pressure from Rep. Dingell by launching an enforcement program to do that. Previously, it had never sued a recalcitrant party in such situations.

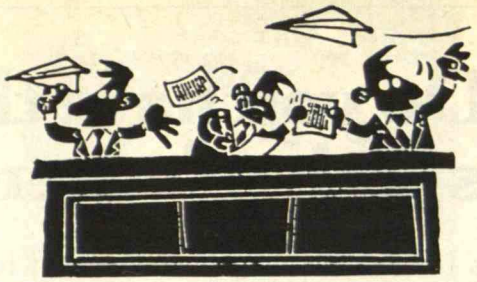
One reason EPA has not been aggressive is that its technical and enforcement divisions have been separate since the Burford years. These divisions have different goals. Richard Mays, who worked under both structures as an enforcement lawyer, says that today the technical side has incentives to take administrative actions and not refer cases to the attorneys. In addition, he says, the separation discourages daily interactions in which attorneys might learn about the technical realities of cleaning toxic wastes, and technical people might learn about the kind of evidence needed in enforcement cases.

The agency is also missing another opportunity to recover costs from polluters. SARA's *de minimus* provision allows parties that contributed only a minor portion of the wastes at a site to pay more than their share in return for early release from liability for a cleanup project. Many companies would find that worthwhile.

Yet EPA has used the *de minimus* procedure only twice. This is partly because of pressure from major polluters that don't want to let other parties off before extensive studies are conducted to assess total cleanup costs. Another reason is that the agency hasn't wanted to take time away from dealing with the major parties. Ironically, the intent of the provision is to eliminate small parties swiftly, so EPA can negotiate more easily with large polluters.

Time for an Overhaul

Many EPA officials say their task in cleaning sites would be much easier if they had more federal funds. Stephen



Smith, an EPA attorney, says the program needs $20 billion over five years to succeed. But Congress will likely be tightfisted in this budget-balancing era. Thus the most feasible solution to Superfund's woes is to overhaul the program.

Of course, the new administration will not be able to resolve the differences among all the parties that have a stake in Superfund cleanups. Nor should it. The debates that arise help to hash out major issues and keep everyone in check.

But the heat of the controversies could be lessened somewhat if the new president convinced EPA to issue the National Contingency Plan soon, along with a clear explanation of its cleanup standards and its methods for achieving them. And if the NCP includes a structure for early actions, the new administration should ensure that this provision is well intentioned and does not merely promote Band-Aid cleanups.

In addition, the incoming administration should improve Superfund's management, which the OTA and John Quarles, among others, have cited as a problem. In part, the administration should choose a Superfund leader who can set a clear course for the program and who is willing to keep Congress abreast of key Superfund decisions and so regain that body's trust. Then EPA would be in a better position to suggest changes to portions of the law that it finds conflicting or unworkable.

The new president also needs to reinvigorate EPA's cadres. For all its political posts, he should choose Washington and regional managers who are willing to work as a team. A new project that sends regional staff to headquarters and Washington staff to the regions for several months is a good start, but so far has involved only a few people in the Superfund program.

The civil service positions should be restructured so they attract—and retain—more career employees. A good first step would be to bring EPA salaries into line with those of the private sector—a move that the General Accounting Office says is permissible when discrepancies are large. Over the long run, this step would cost less than continuing to rely on a large number of high-priced contractors. It would also improve the quality of work. The idea of beefing up EPA's civil service work force has proponents in all sectors, including industry lawyer Frost, former congressional attorney Steinzor, and Sen. Lautenberg. For his part, Sen. Lautenberg suggests stepped-up recruiting and training of young employees, and bonuses and fringe benefits to encourage senior staffers to remain at the agency.

In addition to raising the quality of its staff, EPA should reconsolidate its enforcement and technical divisions. Both Rep. Dingell and Sen. Lautenberg favor this step. It would put EPA in a better position to bring a few tough enforcement cases against parties who do not offer to pay their share of cleanup costs. If it were sufficiently impressed, industry might be more forthcoming with payments, easing the financial pressure on Superfund. That would give the agency an opportunity to focus less on the costs of treatment technologies and more on their effectiveness.

Despite its problems, the Superfund program has spurred industries to be more careful about their disposal of hazardous wastes. And most observers believe the existing Superfund law is adequate for cleaning the waste sites already created. But action must be taken soon to improve the way the law is carried out. If EPA persists in choosing to contain rather than clean up waste, contamination at Superfund sites is likely to recur. The result could be hundreds of "sons of Superfund," contamination that would pose still more public-health and environmental risks. □

JULIE L. EDELSON, managing editor of the independent newsletter Inside EPA, *has been unraveling the intricacies of Superfund ever since Congress enacted SARA in 1986.*

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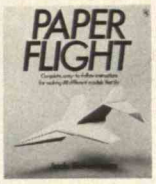
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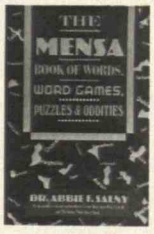
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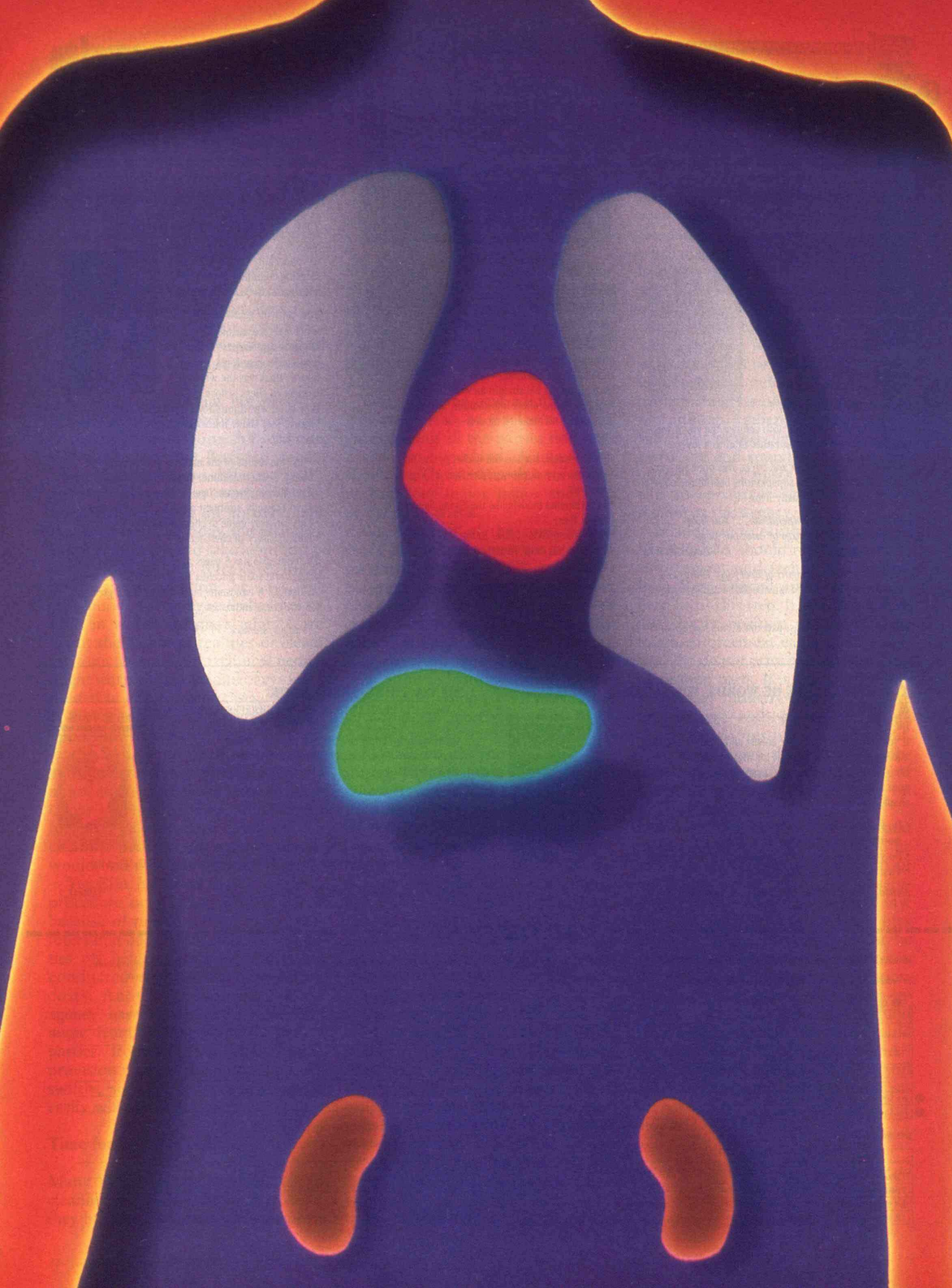
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BY PIERRE M. GALLETTI

Artificial Organs:

Learning to Live with Risk

THE advent of artificial-organ technology has ushered in a new era in medicine. In scarcely more than a generation, artificial organs have evolved from temporary substitutes used in emergencies to devices that can function on a long-term basis. At least 3 million people worldwide live with artificial implants, such as cardiac pacemakers, arterial grafts, hip-joint prostheses, middle-ear implants, and intraocular lenses. Another 300,000 patients are kept alive by dialysis machines—in essence, artificial kidneys.

In years to come, artificial organs will play an even greater role in health care. Several types of artificial skin are already being evaluated in human subjects. Clinical testing of an artificial pancreas for the treatment of juvenile diabetes is now under way. Widespread use of the artificial heart is probably no more than a quarter-century into the future. And development of an implantable lung or kidney might not be much farther down the road. Eventually, artificial organs will allow ordinary, healthy people to live longer—or, more appropriately, to die young at a ripe age.

So far, even the most successful organ substitutes lag far behind their natural counterparts. But the obstacles to better implants are not purely technical. Because such devices require trial and error in human subjects, their development poses a challenge to our cultural and ethical values.

Many patients—like Barney Clark, who died in 1983 after four months on an artificial heart—have volunteered to take part in the testing of unproven medical devices. Lacking alternatives, they are willing to shoulder unknown risks in the hope that others can learn from their experience.

At the same time, such altruism—and the medical progress it engenders—is hampered

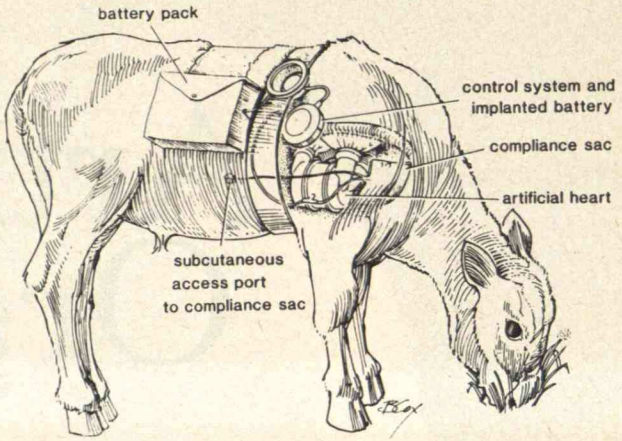
Advances in artificial organs depend on our willingness to rethink the ethical and clinical standards for experiments on humans.

ILLUSTRATION: VISUAL CONSPIRACY/MARTIN STEIN

As each implant approaches reality, experience with human subjects becomes the critical bottleneck.

by medical ethicists and government regulators who call for tighter restrictions on the use of humans in clinical trials of new devices. Their concerns about the safety and effectiveness of the devices and the ensuing quality of life for the patient are well intentioned. Yet the standards they seek to apply are inappropriate.

Over the past 25 years, formal review processes aimed at minimizing the risks to humans have been unable to keep pace with new clinical developments. As a result, they have needlessly restricted the breadth of clinical experience necessary for refining new technologies. It is time for a major overhaul of the approval process for artificial organs.



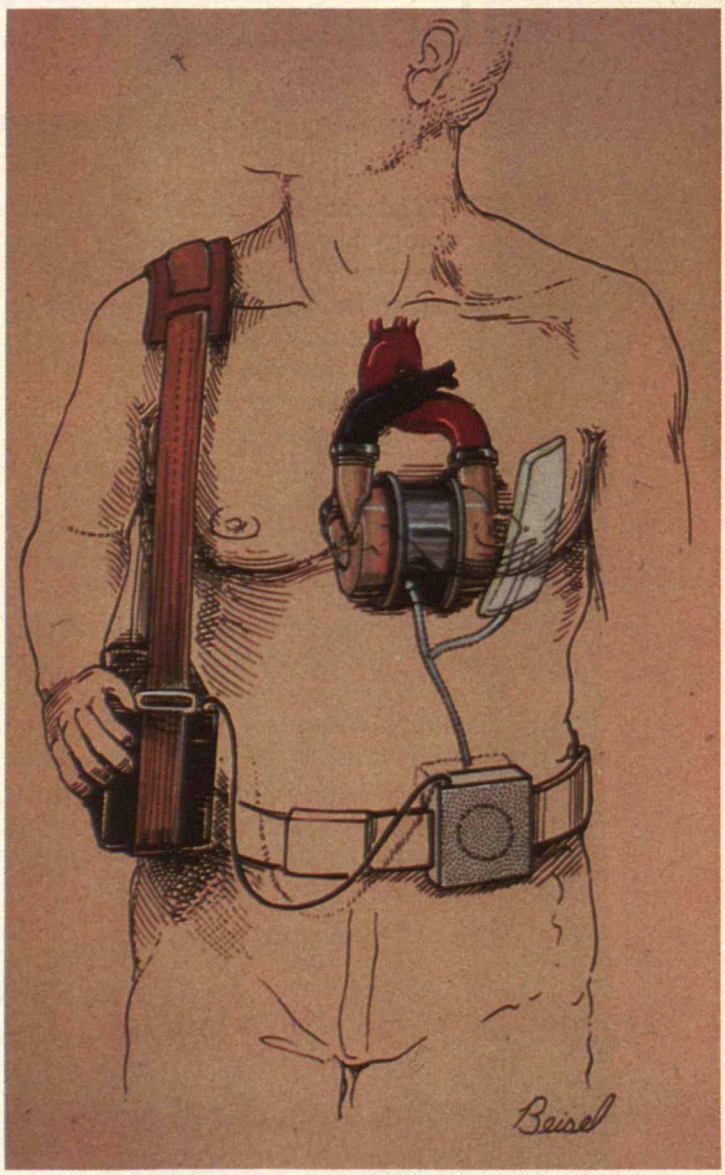
Animal Studies Fall Short

The only way to gain the information needed for refining an artificial organ is through experiments on human volunteers. Research using animals simply will not not suffice.

In the 1970s, for example, researchers competed to develop the artificial heart that could keep a calf alive the longest. Eventually all the calves either outgrew their hearts or died of complications resulting from infections. Neither of these outcomes, however, can reliably be assumed to apply to humans, who generally are no longer growing at the time of implantation, and who keep clean better than calves do. While infection did contribute to the demise of the first six elderly recipients of the total artificial heart, it has been only a minor problem for younger patients who have received similar implants.

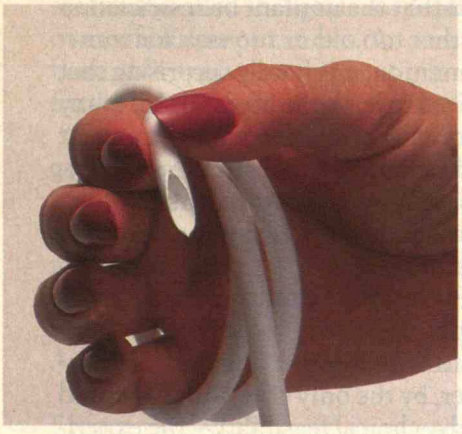
The mechanics of joints also differs markedly from species to species. The replacement of wrists, knees, hips, and finger joints generally poses complex engineering problems because of the heavy mechanical loads involved and the range of motion required. Since there is no generally accepted large-animal model for most of the bones and joints that orthopedic devices are designed to replace, clinical evaluation in humans is the most significant test.

Finally, humans live much longer than most animals. For prostheses that are intended to last a lifetime, animal studies are inadequate.



PIERRE M. GALLETTI is professor of medical science at Brown University, where he heads the graduate program in artificial organs and biomaterials. He has explored the theory and technology of organ replacement for 30 years. Dr. Galletti currently leads a research group focusing on "bioartificial organs"—devices that combine live-tissue transplants with prosthetic materials.





FAR LEFT: The Penn State Total Artificial Heart has proven successful in animal studies. But only implantation in humans can yield the information needed to bring it into widespread use.

Implants such as cardiac pacemakers and synthetic arteries (bottom left) have already become nearly commonplace. The artificial lung (top) requires a far more complex exchange system than the heart and is therefore much further from reality.

As each artificial implant approaches reality, the experience gained from human experimentation becomes the critical bottleneck for development of a widely acceptable device. In the case of the artificial heart, for example, engineering design is not currently the main obstacle. In at least 50 cases over the past two years, heart implants have sustained critically ill patients for a week or more while they awaited transplants. These results were achieved with a variety of designs—total artificial hearts as well as ventricular-assist devices, which operate in parallel with a weakened cardiac ventricle. But in other cases, the same devices have failed to keep patients alive. It appears that success depends less on the particular model used than on the age and overall health of the patient and the quality of postoperative care.

Clearly, what is lacking at this stage are not new designs, improved materials, or innovative surgical techniques but simply more experience. How much blood should be pumped, and for how long? How can the natural heart be weaned from mechanical assistance? How can we assess recovery of the natural organ? When does the risk of the procedure outweigh the benefit of further assistance? There is little justification for developing new engineering designs until these medical questions are adequately answered, and they can be answered only in human subjects.

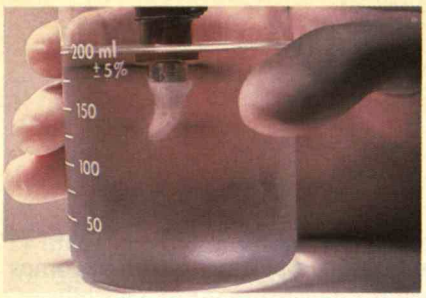
Regulatory Flaws

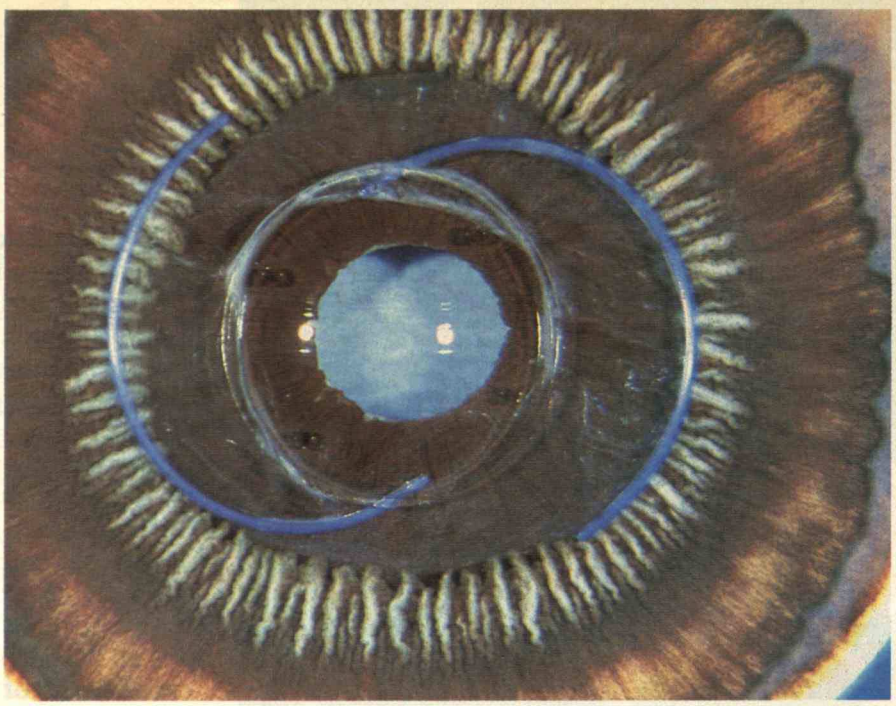
Unfortunately, the Food and Drug Administration (FDA) makes such experimentation difficult. The agency's process for approving new implants evolved in the context of drug evaluation. It works reasonably well for new medications, but produces haphazard results when applied to artificial organs. It discourages innovation, prohibits patients from volunteering for experimental treatments, and prevents necessary refinements from being made in a practical and efficient way.

Federal laws mandate that new medical products be "safe and effective." It is hard enough to prove the safety of a drug, since clinical tests cannot always predict long-term side effects. Ultimately, the decision to market a new drug remains a judgment call.

Demonstrating that a device is safe is even more complex. There is no concept similar to toxicity (the mass of chemical administered relative to body size) that can be extrapolated from animals to humans. Moreover, there is no analogy in organ replacement for the terms "effective dose" and "overdose": implantation is an all-

PHOTOS: PIERRE GALLETTI; SCOTT KILBOURNE/PETER ARNOLD, INC.





Advances in organ replacement may do much to offset the debilitating effects of aging, disease, and trauma. A collagen implant (above) can help heal a damaged or destroyed eardrum. Intraocular lenses (right) have restored the sight of hundreds of thousands of cataract patients.

or-nothing affair.

Nor can devices be tested in the same way as drugs. A double-blind study is out of the question, since both the patient and the doctor must be informed of the specifics of the procedure. And there is no ethical justification for using placebos, such as sham surgery or nonfunctional devices.

Finally, a regulatory process modeled on that of drugs unnecessarily limits minor modifications of existing devices. A new drug is identified by its chemical composition; it is presumed to reflect the best choice among a number of similar compounds. Any change in the chemical formula produces a new drug, which is properly subjected to the full cycle of evaluation. On the other hand, devices typically can be improved without changing their fundamental design—for example, by altering the power supply of an artificial heart. FDA officials often freeze the design of a device when obvious modifications could be made without repeating the entire evaluation process. Inflexibility in pursuit of an orderly trial prevents physicians from making efficient use of the knowledge they gain.

The distinction between drugs and medical devices is not the only one federal law fails to recognize. The FDA's regulatory process ignores the difference between clinical feasibility (proof that a device can restore lost function in a human being, regardless of outcome) and clinical usefulness (statistical evidence that the device works better than other, established treatment methods).

Logic dictates that a device must be found clinically feasible before it can be proved clinically useful. But the FDA's clinical and ethical standards for experimentation involving humans—such as relative safety and effectiveness and quality of life—are appropriate for testing only usefulness, not feasibility.

In the initial experiments with the Jarvik total artificial heart in Salt Lake City and Louisville, for example, the FDA required that the implant be restricted to patients who were either too old or too sick for transplants. Given their condition, it is hardly surprising that none of the patients lived to leave the hospital. Yet many critics argued that further experiments with permanent implantation should be banned, because the experiments had failed to show that the device was an effective form of treatment, and because the quality of life for patients was poor.

If clinical usefulness was the criterion of success, as these criticisms imply, then the experiments were doomed from the start. The patients' health was simply too poor. However, by the only criterion that could reasonably be applied—clinical feasibility—the experiments did succeed: the artificial heart worked.

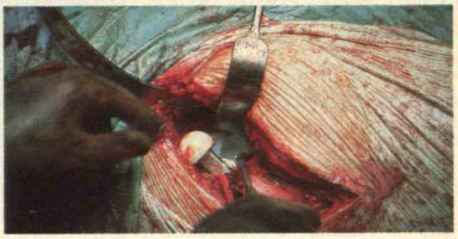
Once the feasibility of the artificial heart was established, the objections to further experimentation with the device quickly became irrelevant. Instead of focusing on permanent implantation, which remains a long way from clinical usefulness, cardiac surgeons now choose to concentrate on using the device in temporary procedures aimed at sustaining younger, healthier patients while they await transplants.

Ironically, these "bridge-to-transplant" procedures

PHOTOS: ALEXANDER TSIARAS, RALPH C. EAGLE M.D./PHOTO RESEARCHERS, INC.







The complexity of human joints and the stress they must bear make joint replacement an ongoing challenge. Titanium knee implants (left) can now be custom designed for each patient. Top, a doctor shows the position for the ball and socket of a titanium hip. Above, an artificial hip is surgically implanted.

have yielded much more experience with long-term use of the heart than arose from earlier implants that were supposed to be permanent. In some cases, bridge procedures have extended from weeks to months when no compatible donor heart could be found; in others, the implantation became de facto a permanent one when patients who had received the artificial heart were subsequently ruled ineligible for transplantation because of medical complications. As a result, researchers have been able to observe applications of the artificial heart for longer periods.

Over the next decade, cardiac transplantation programs are likely to generate enough clinical experience to make permanent implantation of the artificial heart a routine procedure. And these advances will have been made possible only by the so-called failure of the early experiments on humans.

A New Approach to Regulation

Even if the federal regulatory process is reformed top to bottom, the development of artificial organs will still be a lengthy process. There is no avoiding the fact that researchers must examine the performance of each new device over time. Nevertheless, if the review procedure were more rational and predictable, it should be possible to reduce the 10 or 20 years that now elapse between the first successful implantation of a major artificial organ and its widespread acceptance in medicine.

The federal government must balance the goals of protecting patients and permitting the spontaneous evolution of artificial organs. At present, regulations err on the side of protection by allowing too little latitude for experiments aimed at establishing feasibility. Moreover, there are better ways to protect patients: too much energy is spent on regulating experiments and too little on tabulating and publicizing their results so patients can choose wisely among competing treatments.

These deficiencies could be solved if patients' associations (such as the Juvenile Diabetes Association), researchers, industry, and government agencies worked together to allow novel treatments to be investigated in a careful but forward-looking manner. This process could unfold in three stages. The first would begin as soon as there was evidence of a new treatment's promise based on laboratory studies. The sponsoring facility's review board (a body normally comprising community members as well as hospital staff) would decide whether to permit an experiment that would test clinical feasibility—that is, show whether the device functioned as its creators claimed. No more than 10 human volunteers would need to be involved. The FDA would be invited to comment on the protocol for the experiment, but it would have no regulatory authority at this stage. It could not, as it does now, prohibit the experiment, establish criteria for selecting volunteers, or otherwise dictate the details of the procedure. The results of each study would be reported to the FDA, which would then publicize them.

In this way, control over the experiment would rest

PHOTOS: JAMES PRINCE/PHOTO RESEARCHERS, INC.; JAMES H. KARALES/PETER ARNOLD, INC.

Our culture too often believes that success in novel endeavors should be immediate and risk-free.

with those who are to be held liable for its results. Considering that malpractice suits are the most powerful constraining factor in medical treatment today, it is extremely unlikely that any hospital review board would approve the participation of patients in tests of clinical feasibility if they could be treated more effectively with any alternative therapy.

If the results of the first stages were positive, the channel of control would widen to include the federal government. The FDA would decide whether to allow a second stage of experimentation to establish clinical usefulness. To enter this phase, a device would have to undergo rigorous laboratory evaluation of its relative safety, durability, and range of performance. The agency would then establish basic design and manufacturing criteria. A limited number of pilot control trials would be initiated in perhaps half a dozen medical centers nationwide. These trials, however, would again be conducted under the supervision of the local review boards. In determining the protocols for each experiment, the boards could specify that slightly different designs be used in different settings. Thus, the FDA would not have the power to prohibit minor changes in design or protocol.



A woman undergoes dialysis with a portable artificial kidney in Utah's Canyonlands National Park.

At this stage, the government would also be required to establish a standard data-reporting system in which all the patients involved would be registered. This would allow critical evaluation of the new treatment at an early stage, based on the success of the device relative to other modes of treatment rather than an absolute standard of safety and effectiveness. Coupled with a temporary ban on the use of the device outside the authorized pilot trials, such a registry would protect patients against the overenthusiastic spread of unproven forms of treatment.

The third stage would consist of broad-based clinical trials and several years' follow-up. Here, too, the government would be required to keep detailed records. Indeed, a properly planned system for registering patients would do more to weed out inferior technologies, limit costs, and protect patients than concentrating regulatory resources on premarketing control. Government bodies, notably the FDA and the National Institutes of Health, have proved reluctant to devote funds to such registries, since they are expensive enterprises that produce no new scientific knowledge. However, patients seeking treatment need to know which forms of treatment work best—information that often takes years to emerge when the reporting of clinical experience is haphazard. A patient registry could save money, suffering, and occasionally lives.

While this three-stage plan would still enforce a delay in widespread use of a device, it would eliminate unnecessary hang-ups that interfere with the development of lifesaving technologies. Moreover, it would prevent regulatory agencies from attempting to resolve ethical dilemmas unilaterally. Denying access to current technology on ethical grounds hardly benefits the individual who would rather risk "poor quality of life" than die. Protecting the patient against potentially disastrous error and weighing the patient's dual motives of altruism and desperation are matters best left to local determination until clinical feasibility is either established or disproved.

An underlying fallacy of our current regulatory system—and indeed of our culture as a whole—is that success in novel endeavors should be immediate and risk-free. We are not prepared to accept an unproven therapy for which there is no recourse in the event of failure. Yet without the unavoidable accidents entailed in a trial-and-error process, researchers cannot make safer, more effective implants a reality. We must not delude ourselves into thinking that perfect devices will soon be available; even the most ardent promoters of the artificial heart do not expect widespread applications before the year 2000.

If we view the development of artificial organs as a major step in the evolution of our species, we may be more willing to accept trial and error as the norm for progress and less dogmatic about what risks are acceptable. The actions of the FDA will prove but a blip on the chart of human history. But our nation's attitudes will form the framework within which artificial-organ technology is developed and applied for generations to come. □

PHOTO: UNIVERSITY OF UTAH

MIT

NOVEMBER/DECEMBER 1988



PROJECT ATHENA
DID *NOT* SPRING
FULLY FORMED
FROM THE HEADS OF
MIT, IBM, AND DEC.
IT SURVIVED
A DIFFICULT BIRTH
AND A TECHNICAL
TODDLERHOOD.
NOW IT'S READY
FOR SCHOOL.

MIT
NOVEMBER/DECEMBER 1988

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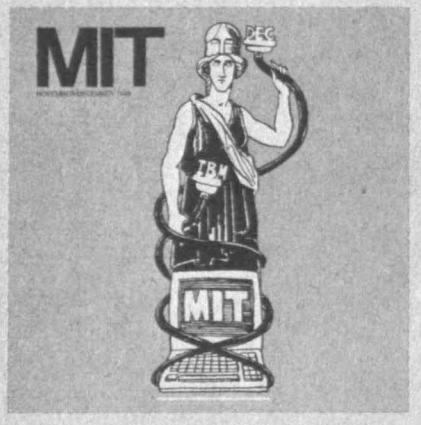
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COVER:
When* Technology Review *decided to run a series of reports on Project Athena, MIT's experiment in the application of high-end workstations to undergraduate education, we knew we would need "visuals." We also knew we didn't want yet another photo of computer terminals. So we turned to Jon McIntosh, whose drawings have graced the pages of this magazine for nearly a decade. We think McIntosh has a knack for enlivening technical or abstract articles with wit and style; we hope you agree.

FOR THE RECORD
JOSEPH WEIZENBAUM

The Computer Is a Mythconstrued Machine

For a relatively new machine, the computer is the focus of a rich mythology. In fact, the myths are sufficiently numerous and repeated often enough to be confused with facts, and many of them are dangerous.

I want to focus here on several of what I judge to be the most pernicious myths surrounding computers—pernicious in the sense that they are routinely employed to justify action or inaction that is antithetical to the best interests of society as a whole. I suspect that many of you subscribe to one or more of these notions:

- We've entered the "information society."
- Computers will take over all the dull and mindless work, leaving humans to devote themselves to deeper things.
- Computers do, and do *only*, what we tell them to do.
- We humans control computers, and not they us.
- Surely the program authors know or can discover what the computer is doing.
- Computer programming is good for the mind.
- The computer is merely a tool.
- The individual is powerless to effect change. (This myth obviously has broad implications; but it is widely accepted with regard to the development of computer technology.)

Let me start with the idea that we've entered the "information society"—a concept that pervades our entire discussion about education in the United States as well as in many other countries. The reasoning goes something like this: "When today's kids come into the work force, there will be hardly a job worth having that won't involve information stored and/or manipulated by computers. Those who know about computers will be much better off—it might even be a way out of the ghetto. Those who don't will be 'computer illiterate'; they will have no future. So it's terribly important that our schools teach about computers."

About 125 years ago, it became possible to telegraph from one end of the country to the other. And I can imagine some farseeing person in 1861 saying "the world is never going to be the same. We are entering the information age. It's going to make an enormous difference that we can telegraph the election news from Washington to San Francisco almost instantaneously. And kids growing up now had better learn something about the telegraph, because we'll never be rid of this." So what should they learn? The answer would have been Morse code. I think it would have been as silly to force Morse code on every schoolchild in America as it is silly today—not only silly, but a huge waste—to make children learn BASIC or any other computer language.

It is true that computers permeate modern life. But so do electric motors; I have three in my watch alone. M.I.T. even devoted a department to them at one time. I'm sure that if all the electric motors were to stop working this minute, American society would collapse within the week. And yet we don't expect ordinary people to know all about electric motors; we don't talk about electric motor illiteracy. So why this computer thing?

The importance of that analogy is that the computer, like the electric motor, is largely invisible today, and it will become even more invisible in the future. Consider a highly technical job, the captain of a Boeing 747 airplane, for example. It has dozens of functions controlled by computer. Two young people who both want to become 747 pilots apply for a training program. They have identical qualifications, except one of them knows FORTRAN. Well, FORTRAN isn't going to help, because it doesn't have anything to do with flying an airplane.

There will be relatively very few people in this world who will program computers. And unfortunately, the kids who crowd into computer science programs here at M.I.T. and at institutions all over the world, who think that if they learn programming, they'll be set for life, are deluding themselves. The fact that there are so many computers doesn't change the argument. There are a great number of automobiles in the world, but only a small number of automobile designers.

Leaving aside for the moment the question of whether any specific computer know-how will be occupationally necessary or even useful in the future, there is another reason for questioning the value of computers in the elementary or high school classroom. I maintain that American schools are even now failing misera-

JOSEPH WEIZENBAUM is professor emeritus of computer science. This column was abstracted from a talk (and lively question and answer period) in the 1987-88 Boston Seminar Series.

ILLUSTRATIONS: JAMES KACZMAN

Teaching BASIC to schoolchildren in 1988 makes as much sense as teaching them Morse code in 1861.

bly at their primary responsibility—to give every student the ability to communicate clearly in written and spoken English.

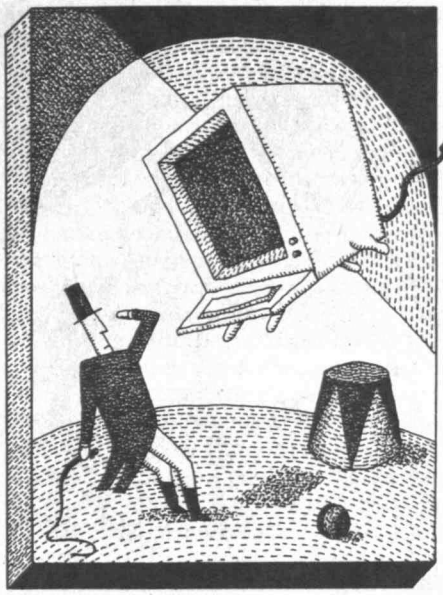
The president of Xerox said within recent memory that fully half of the high school graduates who apply to work for his corporation cannot read well enough to follow written instructions. This isn't half of the high school graduates, let alone half the drop-outs; this is half of the kids who have the nerve to apply to Xerox, who think they know something. In this concrete situation, knowing that the time and financial budgets of the schools are finite, does it make sense to divert resources to teaching PASCAL, for example? To buy computers instead of hiring more teachers? Absolutely not.

Let's go on to the idea that computers will take over the dull and mindless work and leave humans to devote themselves to deeper things. If you want a demonstration of how absurd this myth is, I suggest that you take a roll of film to a one-hour film developing and printing shop. (I've done this virtually all over the world; these one-hour places are almost as ubiquitous as McDonalds.) Chances are that what you'll get back is a set of neatly cut negatives and a nice set of prints. Just what you expected.

But now it may be that you like some of those prints better than others, and you want some of them duplicated and some enlarged. So you go back and ask if they do that. They say "of course." You say "I want two of number 13, and one of number 5, and I want a 5-by-7 print of number 11." You will probably regret starting this negotiation.

You'll get an enlargement back, but the negative will be turned around. You say, "see, there is lettering on there and it's on the wrong side; please print it again." And they won't understand what you mean. You have to specify that this one should be a little darker and that one a little lighter, and the whole thing becomes an ordeal.

The reason for this is, the computer hasn't just taken over the dull work; it's taken over almost *all* the work, providing the employer little motivation to hire—and reward—competent people and providing the employees with little incentive to know what they are doing or improve their skills. It may appear that while you are having your film developed, the people who are operating the machine are thinking about deeper things, like Kierkegaarde for example. In fact, they are incompetent at their job—and quite possibly illiterate. In designing a machine that even an idiot could operate, the industry has created jobs that only idiots would willingly fill and greatly curtailed the quality of all but the most routine service.



On to the next one: that computers do, and do only, what we tell them to do. That seems perfectly obvious. But it isn't true.

The first question is, who is this "we"? Around 1952 or so, I was working on the development of the UDEC computer at Wayne State University. That machine could have filled the M.I.T. Faculty Club dining room. It heated the whole Wayne State Library in winter. But it was vaguely analogous to a PC today in the sense that it would have been possible to surround it with paper and say "what's inside is the computer and what isn't is the outside world." The system existed in isolation. You could think of it as having one input channel—the paper tape reader, and one output—the printer.

Most computers now are part of networks. It's almost impossible today to draw a line around some particular assembly of hardware and say "that's the system." Think of a very large system, say an airline reservation computer, or, if you don't mind having your nerves rattled, think of a computer that controls a nuclear power plant or serves the North American Air Defense Command. Each of those isn't "a" computer, with one person sitting at a terminal telling it what to do. It actually isn't clear where the computer is getting its instructions, who's giving them, at what time.

How do these large, vague systems work? Let me refer to the Senate hearings with Oliver North and Admiral John Poindexter on the Iran-Contra arms deal: didn't they tell that computer to delete those notes? Yes, they typed "delete." The computer apparently didn't do what they told it to do; the notes were found.

We talked about that in the M.I.T. Department of Electrical Engineering and Computer Science. My colleagues and I considered a scenario in which I type in a document at the console in my office, give it a file name, store it, and then want to delete it. What would it take for us to be sure that absolutely no record is left of the document? We came to the conclusion that we just couldn't guarantee it.

Next: We humans control the computer, and not it us. Let's take an example out of very recent history: the use of programmed trading computers by brokers to buy and sell on Wall Street.

Stock brokers certainly think of their own machines as being completely independent of any other computer. The units sit on their desks and are not connected by telephone into a computer network. But these machines receive information from the market, and they are able to communicate with the market—that is, to buy and sell shares. So, in a real sense, they are linked by the market.

Somebody sells 200,000 shares of General Motors stock, the market records that, the other trading computers pick up what the market has just recorded, and brokers act. These computers taken together constitute a system, moreover, one with positive feedback. It is a fundamentally unstable system.

Who wanted that system? Nobody. Nobody didn't want it, either. There are no authors; no one is accountable. I remember that following the Oct. 19 "crash" of the market, there were news reports that James J. Phelan, president of the New York Stock Exchange, tried to put a hold on program trading. Well, there isn't any way that he or anybody else can stop it. Even when we recognize that we have created the Sorcerer's Apprentice, we cannot turn it off.

Programs written by students at M.I.T. are as sloppy and undisciplined as the essays they write in English.

Myth number five: surely the programmers know, or can discover, what the computer is doing. Let me counter with an open secret known to the entire computer science community: Most of the computer systems that actually do the work of the world are incomprehensible. I didn't say that they are not comprehended. That follows: if they are not comprehensible, they are not comprehended. But the situation is worse than that. I mean that no matter what anyone does, these systems are beyond understanding. It is no longer possible to discover precisely what they do.

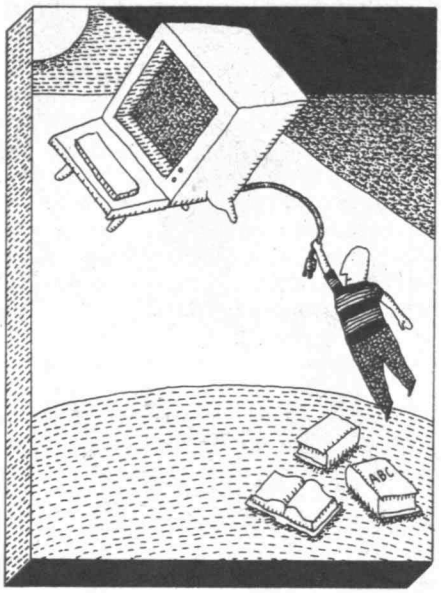
Let me give you a small example. As an M.I.T. faculty member, one of my duties is to be an undergraduate advisor. If a student wants to change his or her registration, wants to drop subject A and pick up subject B, for example, I have to decide if the change is in the educational interest of the student; if it is, I have to decide whether the catalog allows it. Assuming that the answers are yes, I sign a slip of paper that the student takes to the registrar, and, supposedly, it is done.

All that happened. I made those decisions on behalf of a student, signed the slip of paper, and he went away. He was back the next day, saying, "The registrar won't let me do that." Now it's a turf struggle, you see. The registrar has his authority; I have mine. I call up the registrar for clarification: "He says you won't let him do it. What's the matter? Are there any rules against it?" "No, no, no. It's perfectly legal and all that," the registrar assures me, "but our computer won't let us." Now I'm really incensed. "Here's something we want to do in the educational interest of the student, and you're telling me that the computer won't let us do that?!"

"Now wait," he says. "We've learned that under these circumstances, if you get the student to drop subject A, and pick up say, swimming, then come back the next day to drop swimming and pick up subject B, the computer will let him do *that*."

And of course the trouble is that this little registration program, which is doing a tiny part of the work of the world, was written by programmers who have left. Nobody understands that program, and nobody is willing to touch it; it's much too dangerous. So the thing to do is to treat it as a sort of living thing whose "psychology" you understand, but not the organic structure of its "brain."

On the scale of the M.I.T. registrar's



office, an incomprehensible system is an inconvenience; on a larger scale, such as monitoring American air space, our lives may be at stake. How does it happen that systems that begin with a flow chart and a small group who understand everything they are doing get out of hand? I have at least one theory; there are surely others.

Let's say for the sake of argument that we are working for the Ford Motor Company. There is an important problem to solve—fitting a turbo-charger to an already designed engine, say. So the company assembles several of its best systems analysts to tackle the job. But when the project is barely up and running, another important problem surfaces somewhere else in the company; the top team is ripped off project A and assigned to project B.

Now the second string systems analysts, or whatever, have to come in, try to understand what the first team did, and make the system fully operational. That is hard enough to do with the best documentation, but there was no time for the first group to produce documentation. So, without ever truly understanding all the kinks and wrinkles in the system, the second group somehow makes it run, and the company is on its way to another incomprehensible system.

We should be looking for the practices that introduce incomprehensibility into various systems and then stop doing those things. At the very least, the people who design a piece of hardware or software should produce the documentation.

Another myth: computer programming is good for the mind. That's an illusion based on the notion that the computer does only what you tell it to do. It follows that if you tell a computer to do contradictory things, it won't do anything sensible. If that is true, a program must be unambiguous, logical; it can't leave any unanswered questions. And consequently, according to this myth, programming teaches a discipline, teaches the avoidance of ambiguity, contradictions, and conflicts, and teaches a rigor that will carry over into other aspects of life. But that just isn't so.

I could suggest that you look at the lives of the many people who have by now been programming computers for some 25 or 30 years (I include myself here). As a group, can we be intellectually distinguished from people who have not programmed computers? I think not.

But I have a more compelling reason for debunking that myth. Almost all the programs one sees in schools such as M.I.T. do have contradictions and are ambiguous. They have to be shoved through a sieve—debugged to fit one narrow context—so that the one or two times the programs are executed, they are made to produce the desired results. But if you were to apply most programs more broadly, in situations where they really would be tested, you would find that they are just as undisciplined and sloppy as the papers these very same students write in English. (I speak from experience: my students were often appalling writers.)

Penultimately, let me offer you a myth you surely believe: that the computer is merely a tool. You hear this most often when someone is talking about an evil or unfortunate consequence in which the computer has played a part.

Let's say, for example, that computers quite accurately guide missiles with nuclear warheads to places where they are supposed to explode and kill half a million people. If you helped to develop such computers, you could be accused of participating in mass murder. But the rejoinder usually is: the computer is merely a tool.

There are many variations on the theme: Herbert Simon of Carnegie Mellon once said to me, "Look, we live in a democracy. We do the science, we do the technology, and we've elected representatives to make our political decisions for us. If they

decide something we don't like, we can elect different representatives. That's the extent of our responsibility."

Or as some of my colleagues at the Draper Lab often say, "With what I did, we can send men to the moon and bring them back, or we can send missiles to Moscow. But that's a decision I have nothing to do with. The computer is merely a tool."

Those statements might be so if we were operating in the absence of any social context whatever. But we are not. We are operating amidst concrete political and social realities.

I'll give you an example. Suppose you come to my house with a little package, and I say, "Put the package in that drawer." You put the package in that drawer, and there you find an automatic pistol. You'd be surprised. You'd say, "This man talks like a pacifist. What in the world is he doing with a gun in his house?"

I can insist that "I use it to hammer nails into the wall to hang beautiful pictures. I agree, yes, it could be used to kill people. But in itself, the pistol is merely a tool."

Now let's change the fantasy a little bit. You come to my house, and you find hanging on the wall a Japanese sword. You don't say, "Hey, wait a minute, what's this pacifist doing with this weapon?" In today's context, especially in the United States, we cannot help being aware that a Japanese sword is a museum piece, not a weapon.

And so it is with the computer. The computer came into the world—I speak with very considerable feeling about this—in wartime. Its entire development was and is determined by military needs. In the ensuing years, the computer has been made much smaller, much more compact; it uses much less power. How did that happen? If there were no military, would the computer in any other universe have developed just as it developed in our society? It's very hard to believe that there would have been such a push for miniaturization as there has been.

I work in the Laboratory for Computer Science. My colleagues and I know that progress in artificial intelligence—specifically in vision, getting the computer to be able to recognize shapes and forms—is first of all and primarily going to be used to make weapon systems more efficient. In this context, we cannot say that our work is completely open-ended.

Now what follows from that? It seems to me that workers on computers, including at the university, have an obligation to do everything possible to become conscious of the end use of their work, to reduce the psychological distance between what they are actually studying and developing and how those developments will be applied. Then they must ask themselves, "Would I contribute to this end use if I had to do it directly?" If the answer to that is "no," then don't do it. And if some positive effect from the work must be forgone—if we have to give up the moonwalk along with the missiles—that is the price we have to pay for a saner world.

Notice, I'm not saying nobody should work on computers or that nobody should work on vision for computers. What I am saying is that people ought to make an effort to know what the principal end use of their work will be.

That brings me to the last popular belief that I want to discredit. When I make a statement such as the one I just made (about becoming conscious of the end use of one's work) to students and, perhaps most of all, to colleagues, one response that I often encounter is, "It doesn't matter what I do. If I don't do it, someone else will."

I think that the most widespread, deeply seated mental disease in our time, especially in the Western world, is the belief that the individual is powerless, that there is nothing he or she can do. It is of course self-fulfilling.

It is important to see that there are examples where people have effected change, and it is possible for an individual to do things. Perhaps the prime example is Rosa Parks. You may remember her, she's a black woman who wouldn't go to the back of the bus in Montgomery, Alabama, and thereby ignited the civil rights revolution, so to speak.

I think of what happened there as a miracle, and she was a miracle worker. She didn't know on the morning of the day on which she refused to move to the back of the bus that she was about to work a miracle. And it certainly wasn't her intention. But it did happen.

I think that the obligation that I urge on people, particularly in this community, to think about the end use of their work and then decide for themselves whether they want to do that kind of work or not, requires a kind of therapy, a setting-aside of the fundamental illusion that the individual is powerless.□

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A Second Wind for ATHENA

The Experiment Scheduled to Finish in 1988 is in Some Ways Just Beginning

BY SIMSON L. GARFINKEL, '87

When M.I.T. announced the launch of Project Athena in the spring of 1983, it was clearly labeled an experimental undertaking. Digital Equipment Corp. and IBM would provide $50 million in hardware, maintenance, and expertise; M.I.T. would provide faculty, students, technical staff, and $20 million in development support. Together they would find out if a network of high-performance computer workstations could be used to help undergraduates learn better.

That was an ambitious enough project, even for so impressive an alliance. But the question first posed didn't compare to the questions that were actually confronted: Could one campus system serve the needs of everyone from aeronautical engineers to students of Spanish? Could incompatible products from two or more vendors be integrated into a single system so that the differences were irrelevant to users? If so, what was the practical strategy for accomplishing that? How do you administer a system that includes 5,000 user accounts on 1,000 workstations, plus file servers, printers, and oodles of special-function hardware and special-purpose software seeping in at the sides? For that matter, how do you manage the logistics of just getting 1,000 workstations out of the boxes and running?

In July, Professor Earll M. Murman took up the reins from Athena's founding director, Professor Steven Lerman, '72, ready to steer the project through its three-year extension. This seems like a logical time to bring alumni and alumnae up to date. In a series of articles beginning here and continuing in future editions of *Technology Review,* Simson L. Garfinkel, '87, will report on what faculty, students, Athena staff, and M.I.T.'s industrial partners have to say about the project.



In 1983, there were primarily two kinds of computers at M.I.T.: mainframe "time-sharing" machines, and a growing number of desktop microcomputers, such as the IBM PC and the Apple Macintosh, that often featured interactive graphics but lacked the power required for large numerical calculations.

Project Athena envisioned using a new kind of computer—a "workstation"—with the power of a time-sharing machine on a desktop, completely at the disposal of one user at a time. In addition to high speed and compact size, these machines would have exceptional graphics, able to display whole pages of textbooks, complete with equations and drawings.

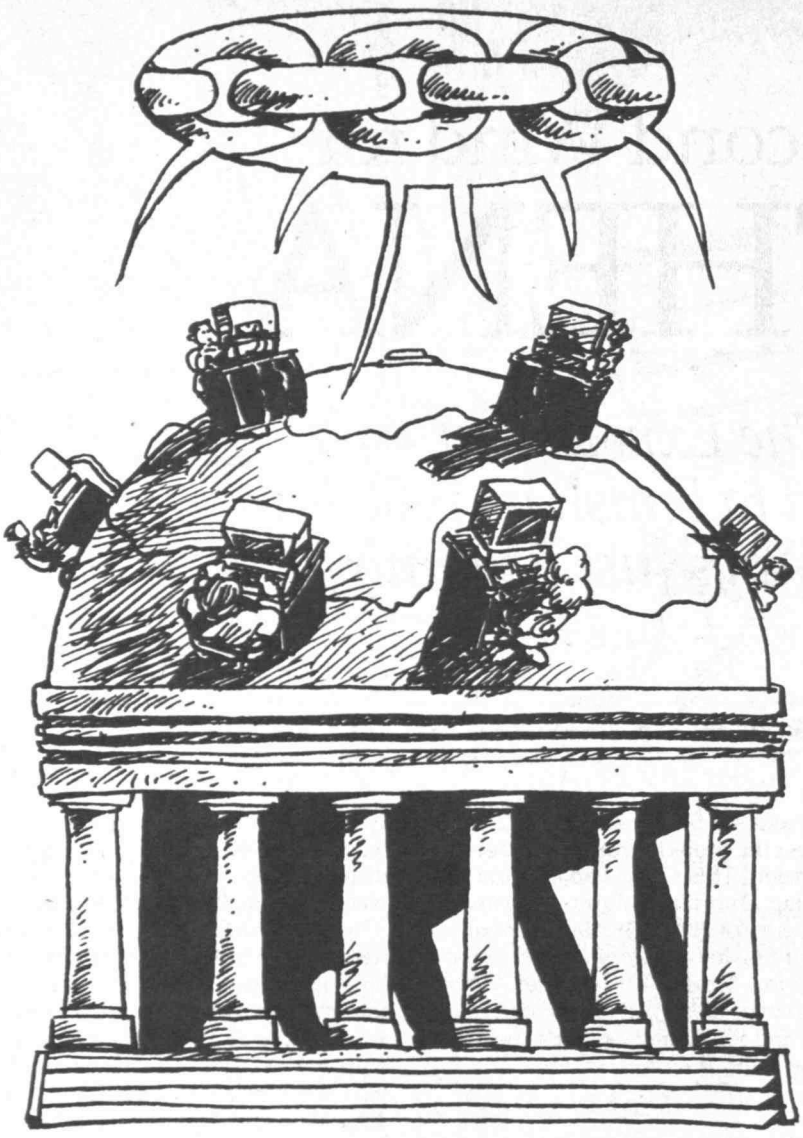
Because the fabled workstations were not available in 1983, Project Athena was broken into two discrete phases. During the first phase, says Lerman, Athena built a campus-wide fiber-optic network and operated 63 Digital VAX 11/750 minicomputers as time-sharing machines. Phase I also called for 500 experimental workstations from IBM. Terminal rooms called clusters—that would later house workstations—were carved out of every possible space. This set-up gave students and software developers a feel for how the new computer environment would eventually operate.

Phase II, in which the time-sharing VAXes and the experimental IBM machines would be replaced with workstations, was originally supposed to commence in August 1985, Lerman says. Instead, delays in hardware and software held it off until 1987.

Athena's mission was always to develop educational software that would be used

SIMSON GARFINKEL, '87, a freelance journalist based in Somerville, Mass., worked on the Chemistry Department's Athena Project. He holds a master's degree in journalism from Columbia University.

ILLUSTRATIONS: JON McINTOSH



by undergraduates, not to do basic computer science research. "The purpose of Athena is to deliver computing to students to do homework," says Technical Director Jerome H. Saltzer, '61. But those involved in the project soon learned that many fundamental software developments were prerequisites to the operation of a large network of workstations. From the operating system to the screen-management system, a lot of underlying work had to be accomplished before the educational software could be developed and deployed.

Says Lerman: "[M.I.T. and its industrial partners] were talking about workstations that were in the development labs at the time. We overestimated our ability to take these and [in a relatively short time] turn them into networked workstations."

Today, Lerman proudly points to some of those basic developments as Athena's main accomplishments. The X-Window System, a program for managing text and graphic "windows" on the workstation, has become a standard throughout the computer industry. Kerberos, a system for enforcing rigorous computer security over a public computer network, has attracted interest from DEC and IBM. SMS, a database system that manages the accounts of Athena's 5000 users, and Hesiod, a system that lets any user sit down at any Athena workstation and automatically access his or her files and electronic mail, are also beginning to attract outside attention.

These are also the results that seem to have pleased Athena's sponsors the most.

"From the technical standpoint—how do you set up a large, complex, distributed system—we've learned a great deal," says Carol Crothers, manager of IBM's University Development Products, which oversees IBM's grant to Athena.

"The X-Window System has been very valuable to us. Because of our close working relationship with Athena, we were able to ship the first commercial release of X11 [an advanced version of X] on the marketplace," she adds. Next year, Saltzer says, X—in conjunction with IBM's own version of the Unix operating system—will be available on the full line of IBM's mainframe computers.

Digital, meanwhile, has incorporated the X-Window System, which it calls DEC Windows, into its entire line of VAX products. Some sources inside DEC say privately that the development of the window system alone was worth DEC's donation to M.I.T.

So far, however, the impressive technical developments haven't had a big impact on students, who continue to use the equipment primarily for word processing. According to a 1988 survey by Project Athena, students use the system an average of 1.95 hours per week for word processing, 1.41 hours for writing programs, and 1.34 hours for doing problem sets. However, as more course-specific software goes from the hands of the developers in the academic departments into the classroom, and as professors assign more problem sets that depend on Athena, the patterns of usage can't help but change.

Lerman notes that the Athena programs, or "modules," in Course XVI have been so successful that the faculty members in the Department of Aeronautics and Astronautics have virtually reworked the curriculum around Athena.

In the Beginning, There Were the Engineers

Gerald L. Wilson '61, dean of the School of Engineering, traces Athena's roots to a 1979 report from the director of the Laboratory of Computer Science, Michael L. Dertouzos. In that report, Wilson says, Dertouzos recommended "that the administration begin to think about networking a large set of mainframe computers in order to broaden the availability of computers to students, both graduate and undergraduate."

"That report was submitted at the time that [Jerome B.] Wiesner was president," says Wilson. "It died. Nothing ever happened to it."

After several years of waiting, Wilson

says, the School of Engineering decided to go ahead: "We in the school decided not to wait for M.I.T., but to make it our highest priority to [create] an environment in which we could explore the uses of computers in education." The school wanted to focus on undergraduates, Wilson says, because at the time undergraduates had no access to computers unless they were enrolled in Course VI subjects that specifically used the machines. Wilson thought that undergraduates were not being given a realistic education, because at the same time computers were being used all over M.I.T. in a variety of research applications.

In 1982, Wilson wrote a proposal to the major computer manufacturers looking for a partner for his school's project. Then he went to the Academic Council and spoke with the deans of other schools. "There was relatively little interest in some schools and none in others," reports Wilson. "Some of them said outright that computers are not a new tool for teaching." Frustrated by the lack of interest on the part of their colleagues, the engineers decided to go it alone.

The School of Engineering finally settled on Digital as the sole equipment supplier for its project. "When that started happening . . . the Corporation—particularly the Executive Committee—wanted to hear what we were proposing. [President] Paul Gray ['54] thought that we really should do this for all of M.I.T. . . . We were asked to go back and see if we could get additional resources to do all of M.I.T." So began a long series of negotiations with IBM, which had just formed its Academic Information Systems (ACIS), a branch of the corporate giant that had the potential to be the kind of collaborator M.I.T. would require.

As a result of those negotiations, Athena became a project for the entire Institute rather than one for only the School of Engineering. Because DEC had already made commitments to the School of Engineering, Wilson says, it was decided that IBM would have responsibility for providing equipment for use by all the other schools. (At the time, about 70 percent of the undergraduate students were majoring in engineering. The figure is about 62 percent now.)

Out of this intentional mix of hardware manufacturers was born the idea of "coherence," meaning that there would be no perceivable difference between running programs on an IBM workstation or a DEC workstation. The screens might be larger or smaller, the keyboards might have a different layout, but programs would run basically the same.



Although computer science research and technical development were never the objectives of Athena, it became obvious that Athena's requirements by way of workstations and a network could not be met until a lot of fundamental work was completed.

In 1983, coherence seemed like a radical proposal. With a few minor exceptions, computers manufactured by the two companies had never been compatible. Programs developed on an IBM mainframe simply would not run on a DEC minicomputer. Even the computers' "operating systems"—the basic programs that allow the user to instruct the computer what to do—have different vocabularies, command sets, and ways of approaching the equipment.

By developing a standard workstation environment, Athena was going to change that. "There was also some sense," Lerman recalls, "of not wanting to come out at the end of five years and find ourselves wedded to [one vendor]."

Digital's initial shipment of 63 VAX 11/750 computers (serving a total of more than 240 users at a time) was to be matched by the shipment of 500 experimental workstations from IBM that would each consist of "a coprocessor on a PC/XT with an experimental display," and would run the Unix operating system, Lerman says. The machine would hold IBM's place on campus while IBM developed its workstation, which eventually became known as the RT PC.

Due to technical difficulties, Lerman says, the experimental machine was never produced. "The ship date for the experimental box and the RT were getting awfully close [together]," Lerman recalls. Eventually, Athena decided to simply wait for the RT and accepted a large delivery of high-performance IBM PC/AT computers



In the beginning, Digital served the School of Engineering (at the time it enrolled about 70 percent of the undergraduates); IBM was to serve undergraduates in all the other schools. Removing that division was one of many steps in the right direction.

in the meantime.

"It was our idea," Lerman says. "It let us expand the base of PCs and get some experience with something that is *sort of* a workstation." Even though the machines could only support a single user running a single program at a time, they were networked and they were "relatively high-performance." (Today, the ATs are being used to monitor and run experiments in laboratories, and some have been made available to student organizations.)

Meanwhile, a growing number of VAX-based clusters had been set up for use by students in the School of Engineering. The idea that students would use the intermediate system was at the very heart of the Athena experiment. That meant that students used prototype hardware and software. And because of the vendors' different delivery schedules and the decision to split the Institute, inequities were inevitable.

Because programs for designated Athena-assisted subjects were installed on particular time-sharing machines, students enrolled in those subjects were restricted to working in a specific cluster. These students were then free to use the equipment for word processing, to write papers for their "non-Athena" subjects. Students who were not enrolled in any Athena-sponsored classes were initially confined to the Student Center cluster, where there were often long lines to use overburdened, very slow computers and printers.

"We had a network but we didn't have a central distribution of software," Technical Director Saltzer explains. To make matters worse, at the times the lines at the Student Center were longest, students were aware that Athena computers in other clusters were often idle many hours of the day.

When the workstations began arriving in 1986, a new problem cropped up: moving programs from the time-sharing machines to the new DEC machines was trivial, but a lot of basic software had to be rewritten for the IBM RTs. The gap was further widened because Athena received the RTs six months after receiving the MicroVAXes, Lerman says; the software on the IBMs took two years to catch up with the DEC workstations.

In March 1987, the first IBM workstation cluster began operation, and by that September the entire Athena system had been shifted over to "Phase II." At that time, the last of the VAX 750s were taken out of time-sharing service and set up instead to provide files to workstations over the M.I.T. Campus Network. Because any workstation can use any fileserver on campus, the restrictions that prevented most students from using clusters other than the Student Center were removed.

"Phase I to Phase II was a very important transition," Saltzer says, "from scarcity to plenty." One student, responding to an Athena survey, wrote: "I used to complain to anyone who would listen about how bad Athena was, but the new workstations are a great improvement."

Today a student can sit down at any Athena workstation located anywhere on campus, type his or her user name and a password, and immediately begin accessing files or reading mail. According to Athena's survey, 92 percent of M.I.T.'s undergraduates have used an Athena workstation at least once—and at least 25 percent of the undergraduate community uses it every day, Saltzer says.

Also gone with Phase I was the idea of dividing the Institute between the two vendors. "It didn't make sense," Lerman says. Project Athena's new video cluster, in which IBM color monitors are attached to DEC workstations, illustrates the degree to which equipment from the two manufacturers is now being blended, he adds.

Today there are 722 workstations on and off campus that students can use, in 12 public clusters and 21 clusters reserved for departmental, living group, or other private use. "The main reason why there aren't more workstations on campus is real estate," Saltzer contends. "If someone were to wander in magically

and say 'you can have 10,000 square feet in this building,' we would have 200 more workstations out in six to 12 months."

But the emphasis of Project Athena from now on will be more expansion into private settings, such as the living groups and the offices of faculty, Saltzer says. And with the cabling that is accompanying the installation of the new M.I.T. campus phone system, Saltzer says, it will be a lot easier to put workstations off in remote corners of the Institute.

Other changes from the original plan include Athena's definition of "coherence." "One of the things I found when I came on board was that there were five definitions of coherence," Saltzer recalls. "Some of the original goals of coherence were research problems," he says, and not prerequisites for an educational computer environment.

One such objective was to be able to write large programs in a variety of languages—such as Lisp, C, and FORTRAN—simultaneously, using each language for what it does best. "We decided that was not an important educational goal," Lerman explains.

"The biggest contribution to coherence has been [the X-Window System]," Saltzer continues. "It has always been the case that a Unix program written in C is mildly portable [from one brand of hardware to another]. The place you get in trouble is where you try to put things on the display." With the X-Window System to standardize display interaction, Saltzer says, "all of a sudden you discover that most programs are portable."

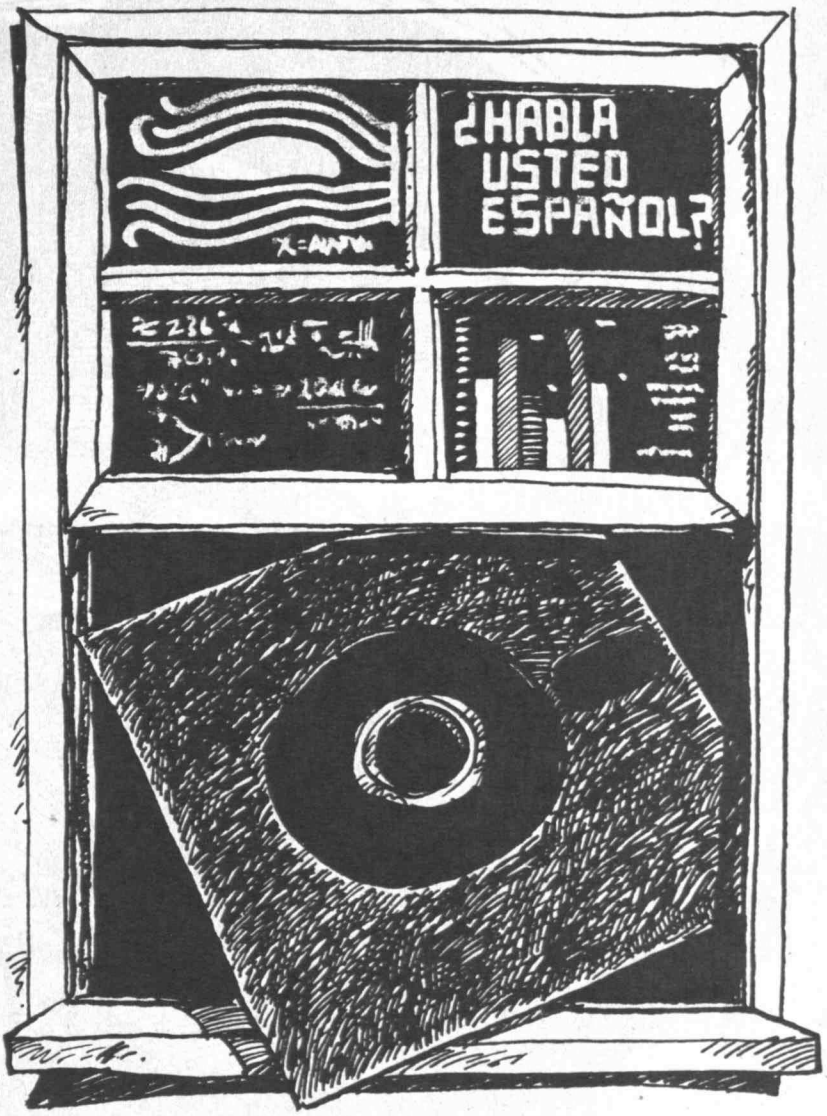
X has even masked seemingly insurmountable differences between DEC and IBM hardware. The DEC workstation's mouse—a handheld device that the user rolls around on the table to move a pointer on the workstation's screen—has three buttons on its top, while IBM's mouse has two. Athena's solution: DEC's middle button can be simulated by pressing both of the IBM buttons together.

If so much has been accomplished, why extend the project for another three years?

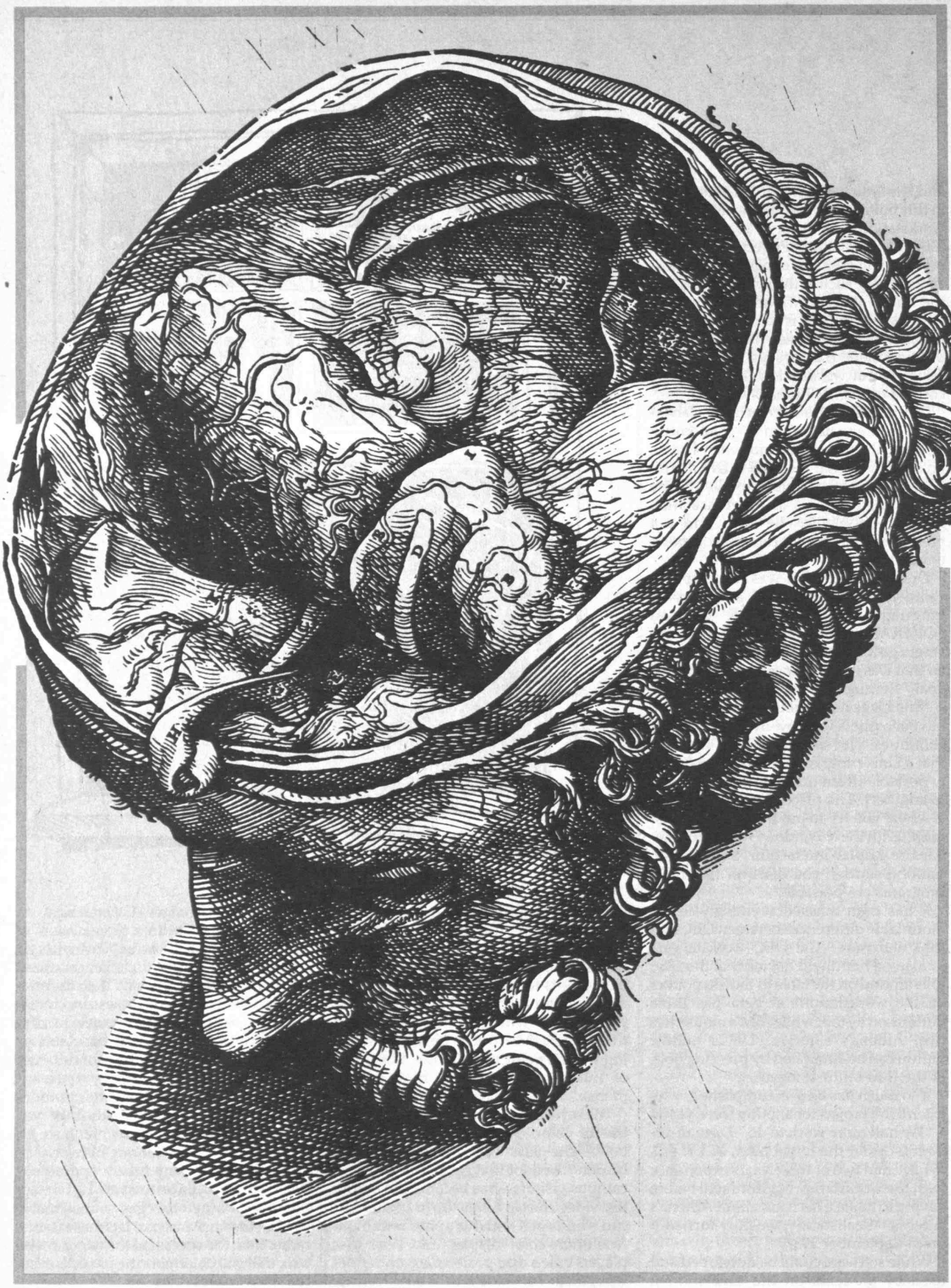
"We had more work to do," Lerman answers. Under the initial plan, M.I.T. was to have had two or three years experience with the workstation environment before having to make a decision about Athena's success. "Realistically, we only turned it on in September 1987."

While software could be developed and used by students on the time-sharing machines, programs that were originally envisioned for the project needed the power of a workstation to perform the necessary calculations. One example Lerman points to is Professor Earll M. Murman's Computational Fluid Dynamics programs, in which a student can watch the flow of a fluid over an airfoil. "Simulating what is going on with the movement of fluids really requires high performance," Lerman says.

"We're just beginning the more extensive use of color," Lerman adds. The "fish bowl"—the glass-walled cluster along the Infinite Corridor that is often ringed with campus visitors—has become the definitive video cluster, where up to 12 students can work, each with his or her own high-resolution color display and laser disc player. Video disc projects are under development in biology, civil engineering, and foreign languages, Lerman says.



And so, at least three more classes of M.I.T. students will participate in this experiment. In a sense, the challenges ahead are much more complicated than the ones that have been solved: Professors can require that students use computers to solve their problem sets, but do the students actually learn better as a result of the exercise? Will that be equally true for non-technical subjects? Will the aptitudes of most students be sufficiently improved to justify the continued maintenance expense of such an elaborate network, let alone the cost of any future upgrading? Will what has been learned at M.I.T. be applicable to other colleges at reasonable cost? In the final analysis, it is these issues, rather than the success of the window system, that will determine the project's eventual impact on education. □



An M.I.T. Brainchild is Exploring New Territories of the Mind

BY JOHN RUBIN AND SETH SHULMAN

Daniel Osherson works with equations on paper. He is interested in the abstract and arcane topic of "inductive inference"—in particular, the theory of how evidence can support a hypothesis. William Quinn toils over collections of fruit flies in a biology lab, trying to discern how small genetic differences can cause subtle changes in memory and learning among populations of *Drosophila*. As unlikely as it may sound, Osherson and Quinn . . . are colleagues in the same department.

The Department of Brain and Cognitive Sciences at M.I.T. represents a bold, two-year-old merger and expansion of the Institute's Psychology Department and its programs in neuroscience developed within the Whitaker College of Health Sciences, Technology & Management. Add to that M.I.T.'s renowned penchant for computational analysis and hands-on engineering, and the result is one of the broadest—and most fascinating—collections of investigators to be found in any single academic department.

As personified by Osherson and Quinn, the department's research runs the gamut from purely theoretical to largely experimental. The idea is to harness the virtual explosion of techniques in two different areas—neurobiology and computation—to open up new avenues of investigation into the workings of the mind. . . . "It is a development that is, in fact, occurring at a number of places," says Robert Wurtz, chief of the Laboratory of Sensorimotor Research at the National Institutes of Health (NIH), "but I think M.I.T. has been much more aggressive at it."



EMILIO BIZZI CHAIRS A REORGANIZED DEPARTMENT THAT BRIDGES COMPUTATION AND NEUROBIOLOGY.

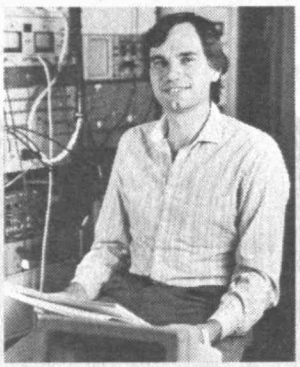
In addition to cognitive scientists and neurobiologists, the department houses researchers who create computer vision and robot systems, or model neural systems. As neurophysiologist and department head Emilio Bizzi puts it: "I do a lot of preaching that brain science is a large but single enterprise. After all, we are all interested in understanding the same things, such as memory, perception, attention, and motion. It's just that the approaches are very different."

In older, simpler times, before the brain began to give up its biochemical secrets, and before computational theories made inroads on the mind, the range of approaches was far narrower. Physiologists and anatomists probed the physical characteristics of the organ while perception and cognition researchers studied its functions. At M.I.T.'s old Psychology Department, the "wet people"—the physiologists and anatomists—were housed in the same building as the perception and cognition faculty. But the two groups didn't work together often.

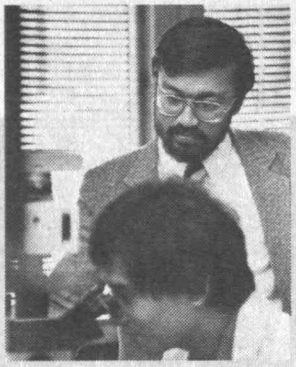
While this may have been typical of many of the psychology departments of the period, M.I.T.'s was unusual even then in one respect: researchers

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PHOTOS: MARVIN LEWITON



RICHARD ANDERSEN TRAINED A COMPUTER TO FORM A NETWORK THAT FUNCTIONS LIKE THE PARIETAL CORTEX.



MRIGANKA SUR IS ONE OF THE SCIENTISTS STUDYING THE MOLECULAR BIOLOGY OF VISION.

ignored huge areas of the field, focusing primarily on perception and neuropsychology. As Richard Held, department head for a decade prior to the merger, comments, "There was never anybody [at M.I.T.] seriously interested in the study of learning, which was the backbone of American psychology in the 1930s, 40s, and 50s."

A turning point came in 1983, when the department's neuroscientists moved from the old building to flashy new quarters in Whitaker College, then a recent addition to M.I.T. Although it had long been recognized that the wet people did very different work from the perception and cognition faculty, the physical separation of the two groups forced a reassessment of the department.

Two courses of action were possible. A minority of faculty members argued that the de facto split be formalized, breaking psychology into a Department of Cognitive Science and a Department of Neuroscience. Some neuroscientists, for example, felt that cognitive science was a weak field, and that they would be better off without it. Meanwhile, some cognitive scientists argued that splitting off as a separate department would define and invigorate their own field.

But other faculty members fought to preserve a single department. One cognitive scientist recalls that some of his colleagues were insecure about the strength of their field and were hoping to use the neuroscientists as a kind of security blanket. And indeed, these hopes proved prescient; neuroscientists have now swelled the department's ranks. "The fact that the department is now larger gives us a visibility and potential weightiness that is helpful to us," explains another cognitive scientist.

In the end, the forces for unity prevailed. "The majority were in favor of a single department, provided that the department doesn't squelch the individuality and peculiar mission of each group," recalls Bizzi. The majority opinion was bolstered by a big push from M.I.T.'s administration, which favored the expediency of a single department.

But what happened next went far beyond mere expediency. Unity did not mean simply continuing the old psychology department as it was. Instead, it resulted in the creation of an entirely new beast. For one thing, 12 faculty members were added in three major subdisciplines, including a first-ever expansion into molecular neurobiology. For another, the balance shifted: "The whole tone of the department now is neuroscience, with cognitive scientists as a subgroup." says cognitive psychologist Mary Potter.

Now two years later, how well is this bold experiment working? Some scientists, including the old psychology department's chairman, believe that the expansion—and the scattering of the department's scientists across campus—has had some costs. "There was a lot of feeling of camaraderie," Held says of the days pre-1983. "We were all in one building, and there was a lot of communication across disciplines."

But most researchers—both within and outside of M.I.T.—believe that new and significantly richer potential for cross-pollination between disciplines within the single department is beginning to be realized. "By combining different approaches, the Brain and Cognitive Sciences program at M.I.T. [is taking advantage of] emerging opportunities in exploring the organization of the brain," says NIH's Wurtz. Adds Potter, "The effects are sort of subtle. But they affect the way you're tuned in, and the aspects of problems that you pick up on and think about."

A prime example of cross-disciplinary work is the study of vision by Associate Professor Richard Andersen, along with David Zipser of the University of California, San Diego, which is spanning the gap between neurophysiology and artificial intelligence. Andersen recently investigated how the brain "knows" where objects are in space. In order to determine that a book is on the table to one's left, for example, the brain requires information about both the position of the book's image on the retina and the direction that the eyes are pointing. Previous anatomical work had shown that these two types of information come together in the posterior parietal cortex, a region of the brain involved in visual processing. One might have expected, then, to find an obvious spatial map in that region—a simple, orderly pattern of neurons encoding the position of objects independent of eye position.

But Zipser and Andersen's neurophysiological study discovered something more intriguing. Over half of the parietal cortex cells they exa-



ARTHUR LANDER WAS A DISCOVERER OF A SUBSTANCE THAT ENHANCES THE SURVIVAL OF RETINAL CELLS.

mined responded in a complicated fashion to both eye and retinal position. Positions of objects, they concluded, are not represented in single neurons, but rather in the pattern of activity of a whole group of neurons.

A typical experimental psychologist would never have done this work; a typical neuroscientist might have stopped with that important result. But Andersen and Zipser wanted to know how such a system might work. So they created a computer network, consisting of a number of processing units connected by links of various strengths, to simulate the many neural connections. They then "trained" the computer model by supplying it with examples of correct solutions: eye and retinal position inputs paired with the desired "brain" output showing the correct direction. After each training session, a "learning algorithm" modified the strengths of the connections between each processing unit until the model eventually learned to solve the problem.

Examining the network after learning was completed, Zipser and Andersen found that it was strikingly similar to what they had observed in the parietal cortex. Information about the location of objects was distributed through the processing units in much the same way as in the primate nervous system.

This achievement—bridging computational and physiological levels—is a rare triumph in psychology. And arguably, M.I.T.'s Brain and Cognitive Sciences Department is now one of the best environments for making such connections. In fact, Andersen is starting to collaborate with computational theorists in the department on another study of vision, the problem of how the eye and brain perceive motion. "M.I.T. has a critical mass of vision and computation," says Andersen.

Yet broad as it is, Andersen's research only covers part of the spectrum of approaches to vision in the M.I.T. department. At one end is the molecular biological work of Mriganka Sur and Arthur Lander. These two neuroscientists have discovered that a substance dubbed fibroblast growth factor (FGF), known to enhance the survival of retinal cells in culture, can also stimulate areas of the brain to forge new neural connections. This result suggests that connections within the visual system during development are guided by FGF.

While Sur and Lander focus on intricate details of neural development in vision, another faculty member, computational theorist Shimon Ullman, studies the broad picture. He wants to know how the visual system analyzes "spatial relations"—for example, how it decides if a certain object lies inside or outside a complicated figure. People do this easily "just by looking," yet the processes underlying this perceptual ability are entirely unknown. Using mathematical techniques and experiments with volunteers, Ullman is testing his idea that the eye and brain first do automatic parallel computations about the shape and color of an image, then put the information together using a series of procedures, or "visual routines."

The same diversity of approaches that M.I.T. brings to vision underlies other research topics. In the study of movement, researchers have done everything from uncovering the principles that allow a pogo stick to hop without toppling over to probing control mechanisms in a frog's scratching.



SHIMON ULLMAN USES MATHEMATICS TO ANALYZE WHAT WE DO "JUST BY LOOKING."

Researchers in vision and motor control are working on fundamental problems—how we see and how we move around. Others are studying a range of questions no less fundamental, such as how children come to speak a language and possess a set of concepts that make the world comprehensible, or how nutrients affect the brain and behavior.

Many of the department's researchers share the view that a full understanding of psychological phenomena will require tying together the results of widely disparate approaches from molecular biology to mathematics. . . .The hope is that progress will come from this gathering of researchers with very different training in a single department. . . ."[Cross-pollination] doesn't come very naturally," says neurobiologist Sur, "but we are often in a situation where we do have to frame our questions in ways that others will understand and that's a good thing."

It is not clear when the major restructuring of the department will fulfill all the expectations of its supporters, but already many agree that a strong foundation is now in place. Says cognitive psychologist Potter, even if current researchers can't take full advantage of the department's new breadth, "the hope is that at least your students are going to avail themselves of some connections that you, the faculty, haven't yet made." □

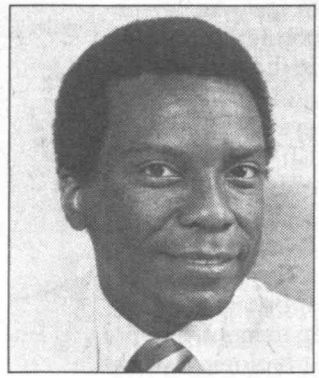
UNDER THE DOMES

New Faces in Old Places

The start of the school year is always accompanied by appointments and promotions as people move on, up, or out in pursuit of their goals. Below are some of the recent changes among faculty and administrative staff.

☐ **Isaac M. Colbert** has been named to succeed John B. Turner as associate dean of the Graduate School. Turner, who has been a key figure in minority graduate student recruitment, retention, and education at M.I.T., announced last May his intention to depart after a year's leave. Colbert joined M.I.T. in 1977 as a senior consultant/trainer in personnel development. Since then he has held the positions of assistant equal opportunity officer, manager of faculty and staff information services, and assistant for information system activities. He received a Ph.D. from Brown University in experimental psychology. Graduate School Dean Frank E. Perkins, '55, has also announced the creation of a new assistant dean position to be filled shortly, with specific responsibility for minority recruitment.

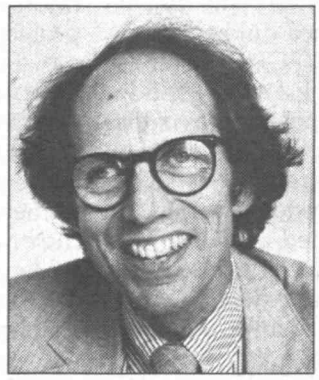
☐ **Emanuel M. Sachs,** '75, has been named to hold the Rockwell International Career Development Professorship, a three-year appointment effective July 1. Sachs, an assistant professor of mechanical engineering, is the second person to hold the chair, which was established in 1986 by Rockwell International of Pittsburgh, Pa., to give young professors with special promise the means to accelerate their progress in both research and teaching. Sach's research has been in the areas of manufacturing and design. After receiving the S.M. and Ph.D. at M.I.T., he was a rehabilitation engineer with the Mass. Rehabilitation Commission, a principal investigator with the Mobil Solar Energy Corp. and then with Arthur D. Little, and a consultant with Solarex. While at ADL he developed and commercialized ESR (Edged Stabilized Ribbon) crystal growth equipment for the low-cost manufacture of photovoltaic solar cells.



I.M. Colbert



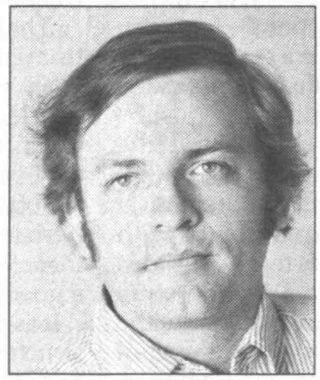
J.W. Tester



W.L. Porter



P. Kaurouma



J.M.D. Schuster

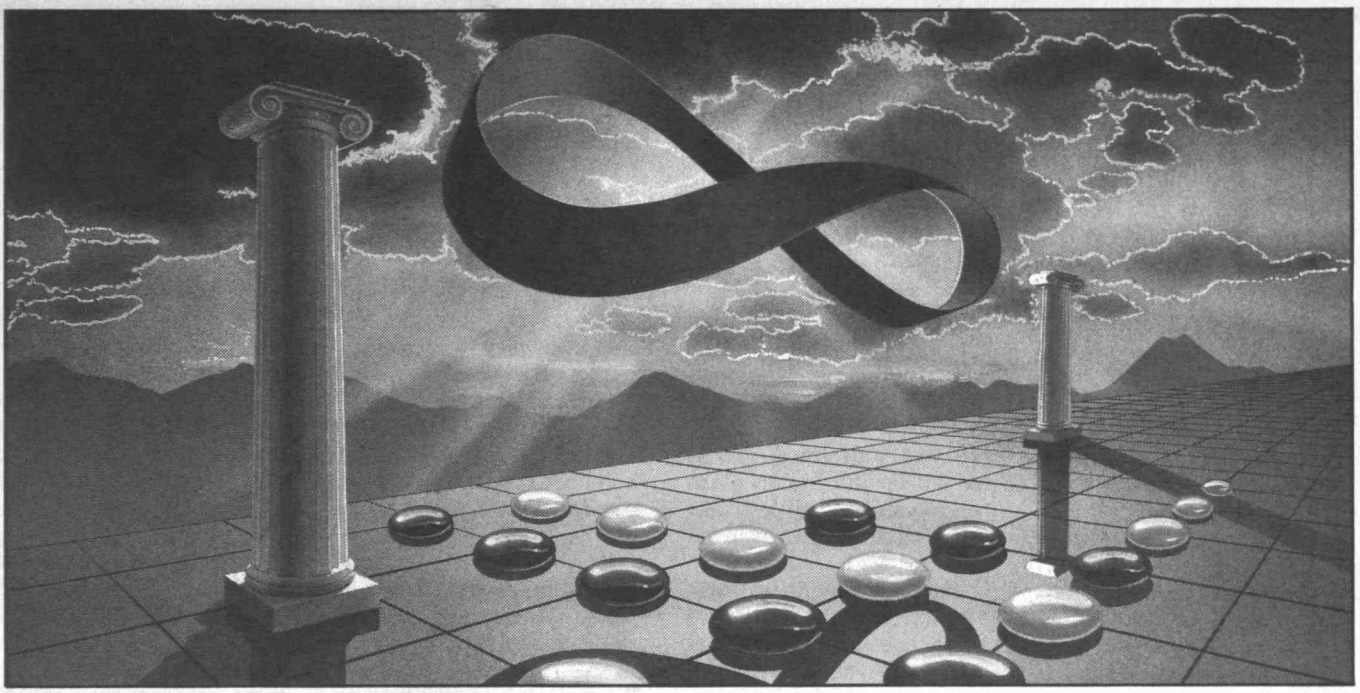
☐ **William L. Porter,** Ph.D.'69, is the new head of the Department of Architecture. In announcing the appointment, Dean Jean de Monchaux of the School of Architecture and Planning praised Porter as "a leading architectural educator, thinker, and innovator." Porter, a former dean of the school and interim head of the department this past year, has a national reputation as a practitioner and advisor on architecture, urban design, and development. He was the cofounder and first director of the Aga Khan Program for Islamic Architecture at Harvard and M.I.T., and is cofounder and coeditor of *Places*, an interdisciplinary journal of environmental design. He received undergraduate and master's degrees from Yale University.

☐ **Patricia Kaurouma,** former dean of student development at Earlham College, has joined M.I.T. as the new associate dean for student affairs and director of the Office of Minority Education. She succeeds Joyce Gibson, who left M.I.T. to join the Efficacy Institute, a consulting group that works with public schools, colleges, and universities in support of minority students. Kaurouma has been a professor of African studies at Vassar and Brooklyn Colleges, and has served in several different capacities as student advisor, dean of freshmen, and student affairs administrator. She received the Ed.D. in educational social foundations and research from the University of Colorado.

☐ **J. Mark Davidson Schuster,** Ph.D.'79, of the Department of Urban Studies and Planning, was appointed to a two-year term as a Cecil and Ida Green Career Development Professor. The position was created by the co-founder of Texas Instruments and his wife to recognize innovative and imaginative teaching by gifted young faculty. Schuster, who received his under-

Continued on page MIT 18

PHOTOS: DONNA COVENEY, MIT NEWS OFFICE



PERSPECTIVES. WE NEED YOURS.

The Institute for Defense Analyses — IDA —provides critical analysis to meet major defense challenges. Working in support of the Office of the Secretary of Defense, the Joint Chiefs of Staff, and others, IDA's professionals bring understanding and perspective to the most complex issues and questions of national defense. This vital mission extends to operational, economic, and political considerations as well as the weaponry and systems with which we defend our nation.

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graduate degree from Harvard in applied mathematics, has gained an international reputation in the field of arts policy, which he describes as "the ways in which government funding policies and other nonfinancial policies shape the arts and culture." His areas of interest include public policy analysis, the impact of public policy on nonprofit organizations, national and comparative cultural policy, quantitative methods, and urban management. He won the Goodwin Medal for teaching as a graduate student, and is the author of *Supporting the Arts: An International Comparative Study.*

□ **Jefferson W. Tester,** Ph.D.'71, has been named director of the Energy Laboratory, a major interdisciplinary lab at M.I.T. Tester, a member of the Department of Chemical Engineering, is an authority on geothermal energy and chemical engineering practice. David C. White, director of the lab from its formation in 1972 until 1984, has been named deputy director. While Tester phases out his activities as director of M.I.T.'s School of Chemical Engineering Practice, White will serve as interim leader of the lab. He and Malcolm A. Weiss have been the Energy Labs codirectors for the last four years. Tester, who received B.S. and M.S. degrees from Cornell University, was promoted to professor last spring. He has also worked at Los Alamos National Laboratory as a group leader in geothermal technology and reservoir engineering. □

"Graduation" Address Via Satellite

The International Space University (ISU) chose a most fitting conclusion to its first summer session. The graduation speech was delivered by noted author and space pioneer Arthur C. Clarke via a geosynchronous communication satellite television link from Sri Lanka. The technology for the event had been conceived (but not patented, unfortunately) by Clarke in 1945.

One hundred and four students from 21 countries completed nine intensive weeks of space-related studies at ISU's host campus, M.I.T. Next year the university will likely be held in France, and its founders envision an eventual campus in space. In between now and then lies the goal of a year-round university at a permanent terrestrial location (see *"Space University Achieves Lift-Off," October, page MIT 18*).

Clarke expressed his delight at finding such a personal use for comsats, which he had not originally expected to see in his lifetime, and shared his view of space exploration as the next chapter of evolution. Space travel, he said, "is a technological mutation...[that] should not have arrived until the 21st century." But owing to the genius and ambition of a few scientists and politicians, the ISU graduates can now "take advantage of this historical accident."

He struck a more somber, balancing note of the "tragic mismatch between our present needs and our capabilities. . . .The Third World needs space technology even more urgently than the so-called developed world." The many kinds of satellites extant and to come—geo-sats, weather-sats, comsats—will play an ever more vital role in reducing the starvation and misery in much of the world, he said.

Thus charging his antipodal audience with both the bonds of responsibility and the unbounded "growth among the stars" of their chosen passion, Clarke wished them well, for they "represent a new evolutionary branch of humanity." □

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R. M. Simon, '72

A. E. Adenekan, '85
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N. A. Campagna, '67
F. W. Clark, '79
W. O. Davis, '51
R. E. Doherty, '87
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W. E. Jaworski, '73
C. A. Lindberg, '78
J. S. Munic, '85
C. A. Noack, '88
J. D. Okun, '75
K. J. O'Reilly, '80
T. A. Taylor, '81
T. von Rosenvinge IV, '80
M. Walbaum, '87
D. W. Wood, '76
J. S. Yuan, '63



The "Jack Barry Field" was officially dedicated at a ribbon-cutting ceremony this fall. The synthetic turf near the tennis bubble was named to honor John G. Barry (right), M.I.T. coach, teacher, and administrator for three decades. Barry retired as Assistant Athletic Director in 1987, but continues on as golf coach. Athletic Director Royce N. Flippin, Jr. (left) and Vice-President Constantine Simonides (center) assist.

ALUM· NEWS



M.I.T. at the Top of Europe

When the M.I.T. Club of Switzerland—awarded a Presidential Citation in 1987 for its enthusiasm, organization, hospitality, and spirit—sponsors a ski weekend, it has the natural resources to do it in high style.

Last April, the club's annual weekend included a tour of Europe's highest and probably most inaccessible hotel, and a ski descent on Switzerland's longest glacier.

Club member Walter Steiner, Sc.D.'77, directed a tour to and through the hotel "Top of Europe" situated in the Jungfraujoch above Grindelwald. Located at 3,450 meters above sea level, the hotel can be reached only by train through a six-kilometer tunnel that climbs up 1200 meters through the north face of the Eiger and the Mönch.

Steiner works for the project management company Balzari & Schudel AG, which was in charge of the planning and construction of the hotel. Included in the design requirements were the abilities to withstand temperatures to below -30C, winds of up to 200 km/hour, and snow loads of up to 3.5 tons/sq. meter.

After the tour, the M.I.T. group opted to return by way of a more unconventional route than the train. Led by club President Robert Lensch, S.M.'83, and Alan Hodgkinson, '82, they skied down Switzerland's longest glacier, the Grosser Aletschgletscher, and through the Lötschenlücke to the village of Blatten, a total of 23 kilometers on skis. Luckily the temperature was a mild -10C with no wind, so a good time was had by all. □

Assembled on the Grosser Aletschgletscher, Switzerland's longest glacier, are (from left) Hans Herriger, S.M.'67, William J. Towle, '59, Faith Towle, Mireille Schlaepfer, Felix Schlaepfer, Ph.D.'70, Robert Lensch, S.M.'83, and Quyen Lam.

Seminar Series Grapple With Vital Issues

Once again, the two dinner/seminar series sponsored by the M.I.T. Alumni/ae clubs in Boston and Washington for 1988-89 cover topics of immediate and far-reaching import. The coming year features a broad assessment of deregulation (Washington) and "Can We Afford a Balanced Budget, or What's Next in an Age of Constraint?" (Boston).

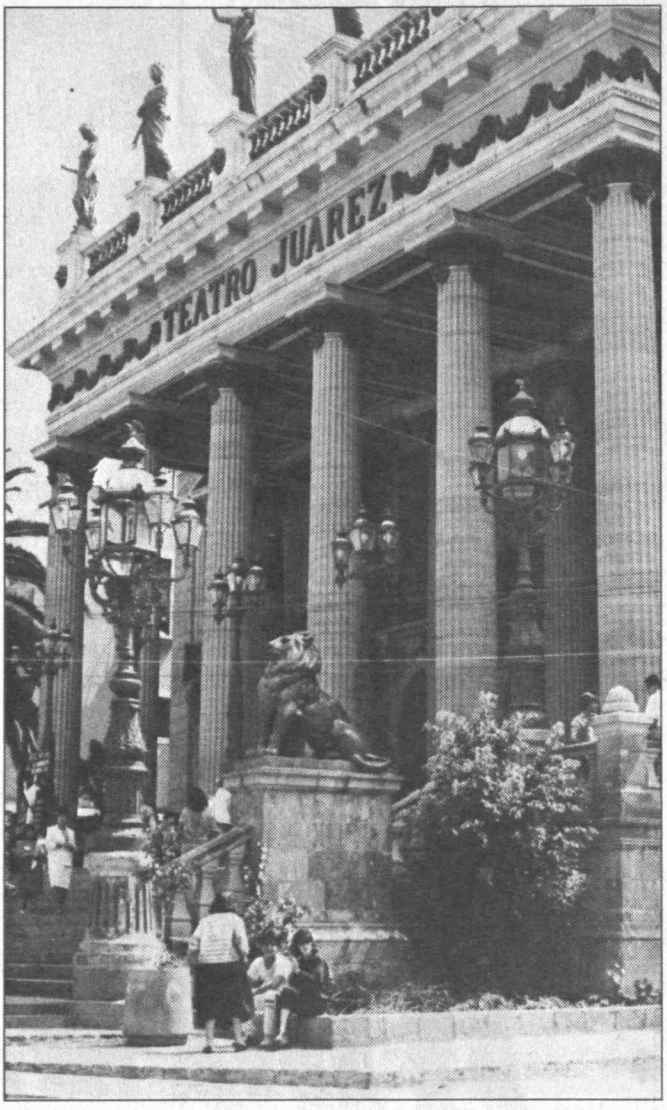
The ninth annual Boston Seminar Series addresses the problems of budget and trade deficits facing the incoming administration, along with the adjustments the United States will have to make to compete successfully in the global arena. Large-scale science programs, housing and health care issues, education and urban policy—how do we integrate funding and treatment of these important concerns with deficit reduction?

Speakers are Rashi Fein, professor of the economics of medicine at the Harvard Medical School; Kenneth A. Smith, '58, associate provost and vice-president for research at M.I.T.; Roy Weinstein, '51, professor and past dean of the College of Natural Sciences and Mathematics, University of Houston; Ann Friedlaender, Ph.D.'64, dean of the School of Humanities and Social Sciences, M.I.T.; Daniel J. Fink, '48, chairman of the NASA Advisory Council; and Alan Altschuler, professor of urban policy, planning, and design at Harvard's Kennedy School. "Big Science and the Budget," "The U.S. Civil Space Program: Frontier or Folly," and "The Search for a Health Insurance Policy" are some of the topics.

The Washington Seminar Series will cover such fields as quality of service and air traffic safety in an era of airline deregulation; deregulation in the financial service industry; and the restructuring of the telecommunications industry. For a comprehensive overview, the series begins with the theory and history of deregulation, and concludes with the view from Capitol Hill.

Scheduled to speak in Washington are Michael Woo, staff member of the House Energy and Commerce Committee; Gabriel Phillips, executive vice-president of the Air Transport Association; Paul Joskow, professor of economics at M.I.T.; DuWayne Peterson, '55, executive vice-president of Merrill Lynch; Gary Epstein, former chief of the FCC's Common Carrier Bureau; James Gattuso, senior policy analyst at the Heritage Foundation; and Cornish Hitchcock, legal director of the Aviation Consumer Action Project.

Each series consists of six monthly dinners from mid-fall to early spring. Anyone interested in the Boston program may contact Scott Glazier at (617)253-8233, M.I.T. Alumni Association. To register for the Washington series or individual sessions, call Albert Bottoms at (202)965-0211 (work) or (202)370-1590 (home). □



The* Filarmonica del Bajio *performed a special concert in Guanajuato for the M.I.T. Club of Mexico's fortieth fiesta. The performance in the imposing concert hall (above) was open to the townspeople as well.

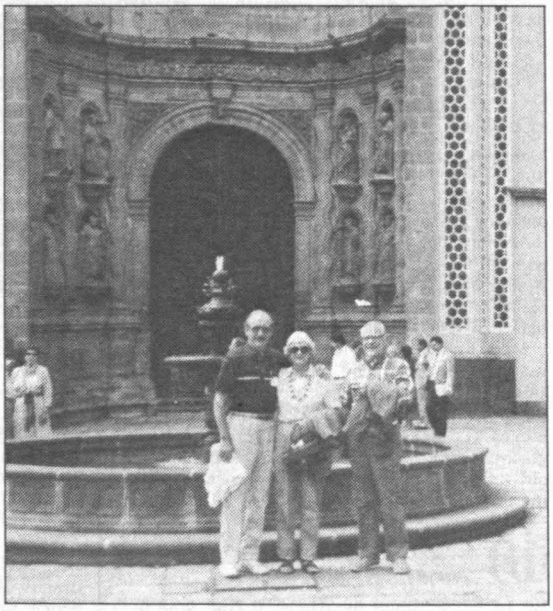
Mexican Fiesta Celebrates Its Fortieth

More than 150 Mexican and American alumni, alumnae, and their guests celebrated the 40th anniversary of the M.I.T. Fiesta Mexicana, hosted by the M.I.T. Club of Mexico.

Highlight of the occasion was an address by Associate Dean of the M.I.T. School of Management Arnoldo C. Hax, a native of Chile, on the school's intensified focus on the management of international businesses and organizations. He spoke at a dinner meeting at the University Club in Mexico City, site of the club's founding meeting.

A panel discussion on recent economic changes in Mexico rounded out the program in Mexico City before the group embarked on a six-day tour of the Sierra Madre mountains in the Bajio region, the birthplace of Mexican independence. Among the stops was the city of Guanajuato, where the

(From left) Maurie Taylor, '42, Helen Laffoon, and Cart Laffoon, '42, pose in front of the Franz Mayer Museum in Mexico City.



fiesta dinner and fireworks followed a traditional *calle-joneada*—a singing stroll through the narrow streets of the mountainside city, led by student musicians from the University of Guanajuato.

The grand finale was the trip back to Mexico City by private rail car. □

—Paul Johnson

PAUL JOHNSON, director of the M.I.T. Enterprise Forum, has been the staff coordinator for Mexican Fiesta for several years.

TECHNOLOGY REVIEW

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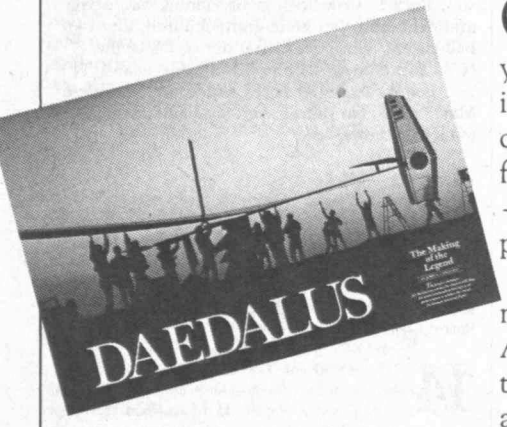
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DAEDALUS

HOW TECHNOLOGY RECREATES A LEGEND



THE STORY OF MIT'S TRIUMPHANT DAEDALUS PROJECT IS NOW AVAILABLE IN REPREINT FORM

On April 23, 1988, after three years of planning, testing and perfecting technology, a 70-pound aircraft called *Daedalus* was pedaled 72 miles from Crete to the island of Santorini – breaking the record for human-powered flight.

John Langford, the project manager for the journey across the Aegean, tells how his team combined technology with perseverance to achieve this new world record.

Because of the popularity of Langford's article, it is available in reprint form. Considered by many to be the most in-depth article on the subject, it allows you to relive this historic event. The reprint is filled with stunning full color photographs that capture the making of the flight.

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CLASS NOTES

07

We hear from Elizabeth DeMerritt Cobb of Martinsville, Va., daughter of **Mrs. Donald G. Robbins** (formerly Mrs. Robert E. DeMerritt), that her mother died February 10, 1987, at the age of 97. Mrs. Cobb writes, "My stepfather, Donald G. Robbins, '07, was well known for his interest in M.I.T. through his activities in the Corporation, the Alumni Association, and his fraternity, Phi Beta Epsilon. M.I.T. was a very important part of his life. My father, Robert E. DeMerritt, '16, was an army officer who died during World War II. His name is on the roll of war casualties in the lobby under the great dome. In 1916 as a cadet colonel in the ROTC, he lowered the flag at the Boylston Street Rogers Building and led the parade across the river to the new M.I.T. I have my mother's very detailed scrapbooks of newspaper articles of this time. My husband, J. Stanley Cobb, received his S.M. in mechanical engineering from M.I.T. in 1947. He has recently retired from the Du Pont Co. after nearly 40 years of service. All three of these important men in my life have always been very appreciative of what M.I.T. has given them and have been most loyal to their school."—*ed.*

08

Franklin T. Towle of West Roxbury, Mass., died July 16, 1986. Franklin retired in 1971 after a 61-year career in the insurance industry. He was the last surviving senior partner in the Boston firm of Fairfield and Ellis. He was an incorporator of the West Roxbury Cooperative Bank and became a director when it merged with the Workingmen's Cooperative Bank. He was a deacon in West Roxbury Congregational Church and a member of its finance committee. He was also a member of the Prospect Lodge of Roslindale and active on several boards and committees at the Faulkner Hospital, assisting in the planning of its new building.

Franklin leaves his wife, Helen (Buss); two sons, James M. of East Longmeadow, Mass, and Alexander Towle of Largo, Fla.; seven grandchildren and nine great-grandchildren.—*ed.*

09

We have four deaths to report: **Mrs. Benjamin W. Pepper,** August 15, 1983; **Harold O. Stewart,** February 15, 1986; **Anthony A. Bonzagni,** December 1986; and **W. Craig Ferguson,** December 8, 1987.

Harold Stewart received his bachelor's degree from the University of Rochester in 1907 and his master's in electrical engineering from M.I.T. After M.I.T., Stewart got a sales job at Rochester Gas and Electric Corp., at a time when most local industry used hydroelectric and steam power. He later designed machinery for the now-defunct Lowenthal Knitting Mills as well as the Voght Co. (now Voplex Corp.). He was married to his wife, Marguerite, for 61 years, until her death in 1974. Stewart was a lifelong resident of Rochester, and friends and family described him as a gracious, outgoing person.

Anthony Bonzagni was an attorney and deputy registrar for the Registry of Motor Vehicles in Boston from 1914 to 1956. After retiring from the registry, he was employed at the Lee and Graham Law Office in Boston.

Baber Ferguson, son of W. Craig Ferguson, writes, "Our only living connection with the Institute is Megan Ferguson Clubb, M.S. '82 (Sloan), his granddaughter. (I couldn't make it into M.I.T., so I had to settle for Harvard.) His great-grandson, Riley Baber Clubb, is 3 months old and could tuck in handily as a member of the next class of '09. Hold a place!"—*ed.*

10

We are sad to report the deaths of **Prof. John B. Babcock III** of Portland, Maine, on February 19, 1986; Karl W. Gasche of Reading, Pa., on March 13, 1986; and **Cecil K. Blanchard** of Allentown, N.J., on March 2, 1987.

John Babcock was a professor of railway engineering emeritus in the Department of Civil Engineering at M.I.T. He joined the faculty in 1916 and was in charge of courses in railway engineering and transportation, construction engineering, and other subjects until his retirement in 1954. He continued to serve as a lecturer at M.I.T. until 1959. He served as placement officer for what was then called the Department of Civil and Sanitary Engineering for 25 years. During World War II, he was the railroad evacuation officer for the Massachusetts Committee in Public Safety. He served in a variety of offices, including president of the Boston Society of Civil Engineers, chairman of the Transportation Committee of the American Society of Civil Engineers, and secretary of the Engineering Societies of New England. He was a member of Tau Beta Pi and was the oldest living national honor member of Chi Epsilon, the national civil engineering fraternity. He received the M.I.T. Bronze Beaver in 1979. He leaves a son, Willard F., of North Carolina, three grandchildren, and a great-grandchild.—*ed.*

11

Gurley C. George of Coconut Creek, Fla., wrote to inform us of the death of her husband, **Gardner C. George** on December 1, 1987. He was the last secretary for the class of 1911.

After graduation, George worked on the Catskill aqueduct, which brought water from the Catskill Mountains to Brooklyn. During World War I, he served as a first lieutenant in the Army Corps of Engineers. After the war, he went to work for Niagara Mohawk Co. in Albany, N.Y., rising from draftsman to chief engineer of the company's eastern division. He also designed hydroelectric plants in Mexico, and worked as a consultant to the U.S. Department of the Interior. He retired in 1962 and moved to a development in Florida called Coconut Creek. Five years later, he successfully led a fight to incorporate this area as a city and was elected its first mayor. During his two-year term, the population of Coconut Creek more than doubled. After leaving office, he continued to serve as a member of the city council for another two years. He also helped to improve his community by designing Coconut Creek's recreation building and designing and overseeing construction of an extension to the Calgary Presbyterian Church. He was a life member of the Institute of Electric and Electronic Engineers, a member of the National Society of Professional Engineers, and a member of the F&AM Lodge No. 499 in Nicholville, N.Y. Besides his wife, George is survived by a daughter, Esther Bloomsburgh of Philadelphia, three grandchildren, and three great-grandchildren.

We are also sad to report the following deaths: Mrs. **Orville B. Denison** of Cornish, Maine, on January 14, 1986; **Stanley H. Lawton** of Cambridge, Mass., on May 19, 1986; and **Edward Sisson** of Chestnut Hill, Mass., on October 27, 1987. No details were available on their careers.—*ed.*

12

We regretfully report the deaths of three classmates. **Jonathan A. Noyes** of Bryan, Tex., died July 22, 1986. He is survived by four children. . . . **Rock L. Comstock** of Milford, N.H., died August 23, 1986. He had retired from Morton Salt of Chicago, Ill. in 1954. Survivors include three daughters: Mrs. Naomi Patterson of Lake Toxaway, N.C.; Mrs. Olive Fallara of Brooklyn, N.Y.; and Mrs. Mollie Miller of Ceder Crest, N.Mex.; a son, Rock L. Comstock Jr. of Vienna, Va.; seven grandchildren; ten great-grandchildren; and two half-sisters, Elizabeth Ostrander of Wellsville, N.Y., and Frances Richmond of Long Island, N.Y. . . . **Lee A. Bailey** of Fort Lauderdale, Fla., died May 7, 1987. No details were available about his family or career.—*ed.*

13

We are sad to report the death of Sarane (Mrs. **Henry H.) Thompson** of Boca Raton, Fla., who died on September 7, 1987. She is survived by her son, Henry H. Thompson, Jr., also of Boca Raton.—*ed.*

14

Hampar T. Gazarian and his wife Vi are doing well, enjoying their daily walks along the ocean, and remembering all the dreams they strived for. He writes that their son Ted is, "realizing the reality of all the impossibles coming true in his computer business." Their daughter, Barbara, sold her radio station in Aspen and is now building a home there. They plan to spend the holidays with their family, which includes four grandchildren and three great-grandchildren. He notes , "We read the *Technology Review,* and feel great

pride in our young people. and a great sense of peace that all will be well."

Regretfully, we must report the deaths of several members of the class: **Leon F. Marsh** of Framingham, Mass., on August 20, 1985; **Roy L. Parsell** of Madison, Conn., on February 26, 1986; **Fred D. Mendenhall** of Tampa, Fla., on August 2, 1986; **Levi B. Duff** of Pittsburgh, Pa., on May 7, 1987; and **Earle A. Mitchell** of Fort Lauderdale, Fla., on May 21, 1988. We must also report the death of Mrs. **Herman A. Affel** of Shelton, Wash., on October 13, 1986.

Leon Marsh was a partner and consulting engineer at Graydon, Smith and Co. in West Concord, Mass., for 18 years, retiring in 1963. He was also a trustee for the Cooperative Bank of Hudson, Mass., and served on the board of the West Suburban YMCA for 30 years. He was a life member of the American Association for Metals and was very active in the Methodist Church. He headed a Prayer for Peace Council at the United Methodist Church of Newton, Mass. He is survived by a son, Milton, of Sudbury, Mass.; four grandchildren; and six great-grandchildren.

Levi Bird Duff served as a field construction engineer for National Tube in Ellwood City, Pa., and for American Sheet and Tinplate in Farrell, Pa., before joining the army in 1917. He served as a lieutenant in the gas defense service and a captain in the chemical warfare division during World War I. After the war, he joined his father's consulting engineering firm and worked as a private consultant on the structural design of public and industrial buildings and bridges. He joined the Allegheny County Works Department as chief engineer in 1936, and ten years later he was made director. He held that position until his retirement in 1974 and then continued to serve as a consultant and researcher for the Engineering and Construction Department. In 1979, he was honored as Engineer of the Year by the Pennsylvania Society of Professional Engineers. In 1984, the Association of Bridge Construction and Design gave him its Distinguished Service Award. He was a member of the Engineering Society of Western Pennsylvania, the Society of American Military Engineers, and the American Roadbuilders Association. He is survived by a daughter, Agnes "Nan" Duff of Ben Avon, Pa.; three grandchildren; and a sister, Catherine Dalzell of Isle of Palms, S.C.

Earle Mitchell served in World War I as commander of a subchaser. In 1958, after 40 years with Phelps Dodge Copper Products in Yonkers, N.Y., he retired as vice- president in charge of manufacturing operations. He was an avid sailor and won many major races on Long Island Sound. He is survived by three daughters: Mrs. Evelyn Blackwell of Schenectady, N.Y., Mrs. Phyllis Harnack of Hastings-on-Hudson, N.Y., and Mrs. Eileen Roberts of Sarasota, Fla. He also leaves two stepchildren: Mrs. Jane Manning of Tavares, Fla., and C. Montgomery Radford of Cornwall, N.Y.—*ed.*

17

Alumni of all age groups have often commented that when they receive *Technology Review* they turn not only to the notes of their classmates, but also peruse those of other classes for news of friends. So won't you let us hear from you?

Unfortunately, the only class news I can report this month is the passing of two classmates. The daughter of **Harold H. Perry,** who received his master's degree in our class has informed us of his death in September 1987.

Samuel Freed's passing this July was reported by his widow, Jean. They would have observed their 63rd anniversary three months later. Sixty-five years ago, he founded Central Electric Co. in Worcester, currently operated by his two sons since his retirement ten years ago. Sam, a loyal supporter of M.I.T., had been one of its Sustaining Fellows. He also was a member and supporter of several civic organizations in Worcester as well as the renowned Worcester Foundation for Experimental Biology.

Please Write!—Don Severance, Acting Secretary, 39 Hampshire Rd., Wellesley, MA 02181

18

As our members decrease, so do the class notes—inevitably this is the case. And this month is no exception.

The one cheering note was from **Herbert Hatch** who has moved from Florida to Auburn, Maine. He writes, "I worked until I was 75, then decided that I liked Florida, and I spent ten winters down there until my wife was declared legally blind. I then became a maintenance engineer (upstairs-downstairs). After five years of that I had a chance to take an apartment near my daughter so here we are. Nothing to do!"

I record with sadness the passing of Narcissa (Mrs. **Samuel H.) Chamberlain** who was an active participant in so many of our get-togethers. Mrs. Chamberlain graduated from Dana Hall School in Wellesley in 1917, and studied interior design in New York. After World War I, she went to Europe and became a volunteer for the American Committee for Devastated France. She married Samuel in 1923, and the couple stayed in France until 1934. They moved to Marblehead, Mass. in 1935. Mrs. Chamberlain was as accomplished watercolorist, and had works exhibited at the Childs Gallery in Boston. She served on Marblehead research and restoration committees, and helped restore the King Hooper Mansion, a historic site that became the home of the Marblehead Arts Association. She wrote several books with her husband, including *Bouquet de France* and other illustrated travel books. Without collaboration, she wrote several cookbooks and *Old Rooms For New Living,* a book on the interior decoration of old New England homes. Her last book was *The Prints of Samuel Chamberlain, N.A.,* an illustrated catalog of her late husband's etchings and other artwork. She leaves two daughters, Narcisse and Stephanie Chamberlain, of Marblehead; and a brother, Donald Gellatly of Mercer's Island, Wash.—**Max Seltzer,** Secretary, 865 Central Ave., Needham, MA 02192; and **Leonard I. Levine,** Assistant Secretary, 519 Washington St., Brookline, MA 02146

19

These class notes for the November/December copy of the *Technology Review* will report on a meeting of the reunion committee, by **Don Way, George Michelson, Doc Flynn** and myself, who met by telephone to consider the question of a 70-year reunion of our class of 1919 in 1989. They concluded that if an official 70-year reunion were held it should be limited to one day and first submitted to the class membership. It was felt that the day should be Friday with attendance at the luncheon of all the reunion classes. A class dinner that evening might be held if enough members were to plan now to attend. The Alumni Association agreed with our committee plan and will poll the class. We shall await the responses and proceed accordingly. We hope all members will respond. We will keep you informed.—**W.O. Langille,** Secretary, P.O. Box 144, Gladstone, NJ 07934

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Ralph Larsen died on March 10. While at Tech, he left to join the U.S. Navy Signal Corps, and became a pilot and flight instructor during World War I. He began his career as a publicity man for the B. F. Keith Circuit. He became associated with Liberty Mutual Insurance Co. as a safety engineer. A resident of Dover, Mass., he leaves a daughter, three grandchildren, and three great-grandchildren.

A note to my brother contains the following information about the **Benjamin Morse** family. Ben writes, "I am still hanging in there. Now have 13 grandchildren and 19 great-grandchildren, another due in June. We have one great-grandson that is interested in M.I.T. Hope he makes it!" Ben describes him as "very bright."—**Harold Bugbee,** Secretary, Apt. 313, Country Club Heights, Woburn, MA 01801

21

There are two deaths to report this month: **Prof. Boris V. Korvin Kroukovsky** of East Randolph, Vt., on June 20, 1988; and **Ralph H. Price** of Austin, Texas, on June 29, 1988.

Prof. Kroukovsky was born in Tanbov, Central Russia. He was educated in military school, majored in engineering and was a pilot in the Russian army during World War I. After the war he and his wife fled 6,000 miles across Siberia and secured visas for Japan and the United States, coming first to San Francisco and then Washington and New York City. He acquired a master's degree in aeronautical engineering at M.I.T. and later was a professor at Stevens Institute of Technology in Hoboken. During World War II he was chief engineer of Edo Corp., building airplane parts for the U.S. Army and Navy.

The death notice of **Ralph H. Price** was sent to me by his daughter Nancy Price Murrow. In addition to the newspaper obit, she sent me interesting notes about his life at M.I.T.—1919 to 1921. Price worked for Standard Oil Company (Indiana) and Amoco and also was associated with Bradfield—Cummins Realtors in Austin. He served in the U.S. Army 1918-19. In his personal notes about M.I.T. life, Price told of consulting professors at both Harvard and M.I.T., and deciding upon the chemical engineering field. He had financial difficulties but managed to borrow from various sources. In his senior year he earned part of his expenses by washing dishes and serving as a night telephone operator on a private switchboard. Even this was not enough, so he went to his department head and reported that it was necessary to drop out of school. Price was asked how much he needed to see him through. The amount was stated, a check was written, and he was told he could pay it back after graduation. The check writer was Professor Warren K. Lewis.

Your secretary had a call mid-August from **Cac Clarke** wishing him a happy 89th birthday. Think of living that old! Cac said he had seen Alex (Mrs. **Munroe) Hawes** and that all was well in that household. I learned that there is a small alley named Hawes Alley in Sea Girt, N.J., where the Hawes live.—**Sumner Hayward,** Secretary, Wellspring House E64, Washington Ave. Ext., Albany, NY 12203; **Samuel E. Lunden,** Assistant Secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

22

Paul S. O'Brien, longtime resident of Baton Rouge, La., received last fall a congratulatory letter from President Reagan for his more than 40 years of voluntary service to the people of his city. There must be others in the class who have engaged in similar socially helpful activities that should be acknowledged. Let your secretary know.

Class president, **Parke D. Appel,** received a letter from Associate Professor Jeremy Wolfe expressing his thanks to our class last June after his appointment as the next holder of the Class of 1922 Career Development Professorship. In his letter, Professor Wolfe explains the general nature of his course, Introduction to Psychology, which is taken by 300 plus students each fall. Members of the Class of 1922 are welcome guests in this class, Course IX, any Monday, Wednesday, or Friday at 3 p.m. in Room 10-250. Park responded with an appreciative acknowledgement including

a brief summary of how our gift came into being at our 40th reunion way back in 1942.

No obits for this issue, thank goodness. Mary and **Oscar Horovitz** have left Newton. Their new address is: Fountain View, 101 Executive Center Dr., 3-112, West Palm Beach, FL 33401.—**Yardley Chittick,** Secretary, Rte. 1, Box 390, Ossipee, NH 03864

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J. Adalberto Roig writes from his hometown of Humacao, Puerto Rico, (Box 456, Zip 00661) saying he has been taking many cruises. These include north and west to Quebec, east to Nova Scotia, south to Guatemala and the Mayan ruins, and west through the canal to Los Angeles. He was on the Queen Elizabeth 2 before and after its restoration. His health has not been very good lately, especially after a hospitalization with a bout of flu. He reports that his daughter and two sons have given him six grandchildren and nine great-grandchildren.

His main handicap these days seems to be his arthritic knees, one of which now has a "ball and socket" joint. This must be especially tough for one who ran low hurdles at M.I.T. and has continued to be active in various organizations as well as his sugar business, where he still works part-time.—**Rock Hereford,** Co-secretary, Hacienda Carmel 90, Box 5397, Carmel, CA 93921, (408) 625-7590; **Russ Ambach,** Secretary, South Bay Manor, 1959 Kingstown Rd., S. Kingstown, RI 02879

25

Ed Kussmaul called from his summer home in Melvin Village, N.H. Ed was greatly pleased to report that the class of 1992 at the Institute will include his granddaughter.

In the October 1988 class notes, we reported that **Charles E. Peterson** had been on a European trip. Sadly, his daughter, Mrs. Freya Jones, writes that Charles died in Bellingham, Wash., on June 8, 1988. . . . Another passing must be reported: **Stephen Freeman, Jr.**, died at the St. Elizabeth Hospital in Lafayette, Ind., on June 2, 1988. Stephen, after working as a transmission engineer for a public utility in Michigan, joined the faculty at Purdue University in 1948 where he taught in the School of Electrical Engineering. He retired in 1970 as professor emiritus. From 1971 to 1977, he taught in the School of Freshman Engineering at Purdue in the counselor tutorial program for academically disadvantaged students. The School of Technology at Purdue then asked him to work in their electrical engineering program. In June 1983, he retired for the third time! He is survived by his wife, Ruth, and four children.—**F. Leroy "Doc" Foster,** Secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

26

Harry Howard's wife, Louise, passed away in March. They were engaged in his junior year and attended reunions regularly, so classmates and their wives may have become friends with her. The Howard home in Orleans on Cape Cod overlooks Nauset Beach. Harry and I had once organized an M.I.T. picnic for the class of '26. We called on Harry and met his daughter, Judith, a Peace Corp volunteer in Honduras in charge of a program that organizes poor mountain families to raise and sell food. Harry's granddaughter is a graduate student at Harvard and has been teaching on the Cape this summer. Harry keeps busy tending his beautiful garden in the summer and being active in the Orleans Historical Society and other organizations in Orleans.

John B. Wilbur's wife, Lillian, died June 30 after a long illness. . . . **Jim Drain** writes that he and Betsy have lived for five years in Sherwood Oaks, a life-care community in Mars, Pa. They also have an apartment in Florida. It is wonderful to hear of classmates who are enjoying life. I wish we all were.

Alton B. Staples writes a long and happy letter from his home in Chatham, Mass., overlooking Pleasant Bay. He attended Technology Day on June 3, but our class group didn't see him and his wife, Helen, until the end of the luncheon, as he got a table numbered 26 some distance from the '26 table. Theirs was directly underneath the Daedalus, and a member of the crew sitting next to Helene gave her many details of the flight. They have three sons (two of the M.I.T. '51 and '59 classes), eight grandcdhildren. Alton gives credit to God and M.I.T. for a good start in life.

His wife, Sherry, writes that **John Ostberg** died May 10. He had been ill for several months with tumors on the brain. They have been to our reunions, including the 60th. He was born in Norway and came to the U.S. when he was 8 years old. He was a design engineer at several places until 1951 when he started his own office, which he operated until 1986. He was active in a number of technical as well as social societies. **Richard P. Stower** died of cancer March 13. His son, Robert, notified us.—**Donald S. Cunningham,** Secretary, 27 Lowell St., Braintree, MA 02184

27

Jerome L. Spurr, lieutenant colonel (retired) of Wellesley Hills, Mass., presented a slide program and lecture last March in Belchertown on the construction of Winsorr Dam in the 1930s. This dam and Goodnough Dike impound the Swift River and Beaver Brook and are responsible for holding back the waters of the huge Quabbin Reservoir. It is the main water supply for Boston. During the 1930s, Jerre was the engineer in charge of boring and soil exploration, as well as quality control on the construction of both the dam and the dike. They have stood the test of 50 years of service. The Quabbin program was sponsored by "Friends of Quabbin" as part of the 50th "Commemorative Year" observances decreed by Governor Michael Dukakis.

Further information was received about **Robert S. Hatch,** whose death was reported last month. His wife, Anne, writes: "Bob was with Texaco from the year he graduated until 1947. His last position was manager of purchasing. Then he transferred to American-Arabian Oil Co. in the same position, still in New York City. In 1953, he opened an office for the company in The Hague, and subsequently in Japan, Australia, Beirut, Lebanon, and Rome. Soon after he was made executive vice-president.

Nearly two years later he was transferred to Aramco's home office in Dhahran with the title of general manager of purchasing, with Aramco Services still under his jurisdiction. After 10 years in 1965, having been made vice-president, he retired at age 60.

"It was a wonderful experience—every other year we got three months vacation and usually traveled the world. Both of us enjoyed visiting foreign lands. Bob had emphysema, which required him to breathe oxygen for many months in and out of a hospital and nursing home, and he suffered a great deal." Thank you, Anne, for this more complete history of your life with Bob.

Edward H. Damon of Bartlesville, Okla., died June 15 after a recurrence of cancer. A chemical engineer, Ed worked for the Cabot Co. in Pampa, Tex., from 1927 to 1936, where he served as chief chemist. He became manager of Moore County Carbon Co. in 1936, a subsidiary of Phillips Petroleum Co., until 1947. From 1947 to 1960 he was vice-president of Phillips Chemical Co., where he served in many capacities in the manufacture of carbon blacks, synthetic rubber, plastics, fertilizers, and chemicals. He took early retirement in 1960. From 1960 to 1975 Ed and his wife, Shirley, traveled throughout the world, mostly on cargo freighters. In 1964 they went westerly around the world in four months, and in 1974 easterly in five months, with one month in the Persian Gulf. Our file holds a dozen cards sent from all over the globe to our prior secretaries, **Joe Harris** and **Joe Melhado.** Think of the pictures they must have accumulated! Our sympathy is extended to his widow and their large family, including his son Robert, M.I.T. '52, also a chemical engineer.—**Joseph C. Burley,** Secretary, RFD 1, Epping, NH 03042; **Lawrence B. Grew,** Assistant Secretary, 21 Yowago Ave., Branford, CT 06405

28

For a beginning, may we wish all of you pleasant holidays in the weeks ahead and a good brave start into the new year!

A flurry of notes and letters followed in the wake of our now historical 60th reunion. The communications contained mostly commentaries on that great event along with many expressions of appreciation. For all of these, we are pleased and grateful.

Velma and **Charlie Worthen** were unable to be with us in Cambridge, but they did receive one of the reunion group photograph prints. They expressed amazement at the size of the turnout and thought that everyone there looked remarkably well. . . . **Jim White** was especially grateful that he could attend the 60th since, in the past, business always seemed to interfere with reunions. However, he did attend the 25th with all of his family. . . . **Eleanor Pepper** was so impressed with the full color panoramic group picture she ordered an extra print to send a family member in Europe. . . . **Harlan Paige** sent copies of the T-Day Memorial Service program to **Walter Hildick** and to **Ev Lester.** This gesture was well appreciated since neither of the latter had been able to attend the reunion.

One might think that a five-day reunion would be a heavy strain on a group of octogenarians. Not so, apparently; no reports of exhaustion have reached us—on the contrary, some used the occasion as a springboard for further activities. Ellen and **Larry Glassman,** after a few days of rest, took off for Hamburg, Germany, and two cruises in northern European waters aboard the *Vistafjord*. . . . Anne and **George Palo** tucked in eight visits with friends on their trek home from Cambridge to Knoxville for a total of 16 days away from home. Yet all of this was just a warmup for a month-long trip to Minnesota only a few weeks later. . . . Nor did **Ellen Batchelder** hurry right home. She and daughter Linda went on from Cambridge to visit with relatives on Cape Cod before finally returning to California. Unfortunately, Ellen did end up with a bad case of bronchitis. We are glad to report that she is now well recovered. . . . **Ed Ure** said that the five days gave him a wonderful opportunity to talk with just about everyone there.

Our reunion even made it to the news media in Florida. The *Orlando Sentinal* of Sunday, July 3, carried the story of **Carroll "Smitty" Smith**'s trip and attendance at his 60th class reunion at M.I.T. A local reporter happened to hear of the event and called on Smitty for details. . . . And speaking of newspapers, we have a very large piece of news from Marie and **George Chatfield,** who have just sold their 48,562-circulation newspaper, *The Montachusett Review.* This is too large a story to fit in now, so we will take it up in a later issue.

Two of our prominent classmates, now deceased, have families that are initiating Institute-based memorial projects. The family of **Robert S. Harris** (deceased December 24, 1983) has established a memorial lectureship for Bob in the general field of biology. . . . The family of **James Donovan** (deceased October 16, 1987) has inaugurated a student aid fund in Jim's name applicable to the Department of Chemical Engineering. Both of these projects are still in an early development



Those who complain about injustices in the world—yet succumb to the notion that one or two small voices constitute no more than futility—have much to learn from Professor Emeritus-Artist Fayette Taylor, '29, and his wife Alice. For 40 years they have provided encouragement and small scholarships to enable more than 2,000 black youth from Boston to attend college.

Along with raising funds through teas and benefits, the Taylors have also served as guidance counsellors and as a repository of college information. They have involved many of their friends over the years and have many success stories to share.

The money doesn't go as far now—a stipend of $100 took a big chunk out of the $325 tuition bill at Boston University in 1951; today the average scholarship of $825 barely pays for textbooks—and after years of increasing black enrollment at state universities, the percentages are heading back down. But Fayette and Alice Taylor continue to make a difference.

stage. Contributions to either or both may be made through the Alumni Fund and would be most welcome.

It is with deep regret that we must report the following two classmate deaths. **James B. Greeley** died April 4, 1988, after a short illness. We were informed of this by an estate trust officer. James graduated in Course 9C (mathematics teaching) and received his master's degree in that same department. His life work was in education, mostly as a professor of mathematics and as head of the Mathematics Department of Utica College of Syracuse University. . . . **Nathaniel White** died June 19, 1988. This information was received in a note from his daughter, Sally. Nathaniel graduated in Course 6 (electrical engineering), and his professional career was in that field. He served with the U.S. Army (mostly in a civilian capacity) for 33 years until his retirement. In the field of radio transmission, he helped to develop international frequency management mechanisms. We extend our heartfelt sympathy to the families of these deceased classmates.—**Walter J. Smith,** Secretary, 37 Dix St., Winchester, MA 01890; **Ernest H. Knight,** Assistant Secretary, Box 98, Raymond, ME 04071

29

Nathan Promisel of Silver Springs, Md., writes, " I have been doing consulting work in materials science and engineering and national materials policy. I am cutting down my work load but I am continuing my work with professional societies, particularly with two of them of which I am a past president. Exciting times and opportunities in science. Good luck to you." . . . **J. Wesley Walters** of St. Paul, Minn., writes, "On June 27, 1988, we celebrated our 59th wedding anniversary and our daughter's 50th birthday. Best wishes to you and the rest of our classmates." . . . I have a note from **Henry F. Robbins** of Gillette, N.J., which states that he has retired but keeps busy just the same with taking daily walks and, during the summer, he and his wife Anne tour the New England States. He says, "I am aiming to complete 2 million miles of driving without an accident nor a traffic violation. This proves that it can be done with care." Henry's hobbies include listening to music, attending to lectures, and tape recording live music.

One of our distinguished members of the class, **Prof. C. Fayette Taylor** of M.I.T. and his wife Alice of Brookline, Mass., were recently interviewed by Anne Wyman of the *Boston Globe* staff. Here are some excerpts from it: "Over the past 40 years, Alice Taylor and her husband Fayette Taylor (a retired professor of mechanical engineering from M.I.T.) have helped more than 2,000 young Boston black people get a start in life by guiding them to the right colleges and raising the money for small scholarships to get them there. Their alumni include lawyers, doctors, nurses, teachers and business men and women. Yesterday, the couple—now both in their 80's—was honored for their work in creating the Educational Counseling Committee of Boston as part of the 125th anniversary of the Dimock Community Health Center in Roxbury. Alice Taylor, a former social worker and guidance counselor said in an interview at her Brookline home that a tiny volunteer committee had raised most of its funds at tea parties in white suburbs like Weston and Concord. The money still comes from individuals with additional grants from area corporations and foundations and from three Roxbury churches. But Alice Taylor is concerned that students' needs are growing while the income is shrinking. 'If you never heard of the committee,' said Joel Hurwits, Dimock's unpaid director, 'it's because we never had the money for publicity.' Last year, the organization raised $30,729 to fund 24 scholarships at a total of $21,176. Most of the operation expenses are borne by the Roxbury Multi-service Center where the committee has been located."

Our 60th Reunion: Your reunion committee has held a number of meetings at the M.I.T. Faculty Club in recent years and the consensus has been to hold our reunion at M.I.T. campus, like most of the upper classes. While your secretary and **Putman Cilley** of Sharon, Mass., were attending the 1988 Technology Day luncheon, we learned that the Class of 1928 was holding its reunion at M.I.T. campus, making McCormick Hall their headquarters. Some of our friends in the class informed us that accomodations, the food and services were very good. On top of all that, our lodging expenses will be half of what a decent Boston hotel would charge and we would be isolated from the M.I.T. community of other class reunions. By the time you read these lines, you must have received the committee's tentative schedule and notice for dues and reservations. If you have not done so, please reply as soon as possible, as we would like to have a good turnout. This may be our "Last Hurrah" and let us make a good one.—**Karnig S. Dinjian,** Secretary, P.O. Box 83, Arlington, MA 02174

30

From Albuquerque, N. Mex., **Bill Perret** reports that having been born on February 29, 1908, he had the "statistical precocity" of celebrating his 20th birthday this year, as well as his 50th wedding anniversary. Upon checking my records I found that he is the only member of our class born on February 29. Bill retired in 1973 from the Sandia National Laboratories where his field of expertise was geophysical analysis of the effects of nuclear explosions. . . . **Irvine (Ted) Ross'** retirement from GE in 1969 and his manifold post-retirement activities have been previously chronicled in the Notes. In his latest report he revealed his plans to retire in June 1988 after 38 years as choir director of the Memorial Baptist Church in Fort Wayne. It appears that Ted's wife Betty, his three children and other members of the Ross family share his interest in music and have been members of the choir at one time or

PHOTO: SUZANNE KREITER, BOSTON GLOBE

another. He hopes that "some other equally inspirational and satisfying method of living a statement will present itself." . . . **Arthur Roberts** has retired from his position as chairman of the Department of Manufacturing Engineering Technology at Norwalk State Technical College in Norwalk, Conn., and like many of our classmates has moved to Florida, specifically Miami.

We now have a report on **Win Hartford**'s trip to Turkey and India for the International Executive Service Corps. His stay in Turkey gave him an opportunity to appraise Soviet technology in chemical manufacture. His estimation: "Health and air pollution good; water pollution problems very bad." In India he had an opportunity to talk with high government officials and private industry about India's energy problems and the use of their high-ash coal. He also addressed a chemical engineering seminar at the Indian Institute of Technology in Bombay on "Environmental Science and Environmentalism," which he says are two quite different fields. . . . In response to my request in the April issue for information about classmates from whom I have never heard, **John Scheuren** writes that he met **Jack Jarosh** at Logan ariport in 1963 and that Jack looked "as fat and sassy as usual." John's letters nearly always include some sort of colorful anecdote that can be used to enliven the Notes. In this case the mneumonic aid that triggered his recollection of the Jarosh meeting was an incident that occurred at the American Airlines check-in counter. It seems that his luggage comprised two bags, each containing a newly-designed 851b recording penetrometer that he was taking to a desert area for terrain analysis. When he placed the bags on the scales, the pointer spun around past its limit and the scales broke down. He was able to persuade the airlines man to accept the overweight bags, but the man gave John a "pitiful look as he had to drag the heavy bags to the conveyor." Maggie and John were planning to return to Tucson in September 1988 and I hope to see them at one or more of the Tucson M.I.T. Club meetings during the winter.—**Gordon K. Lister,** Secretary, 294-B Heritage Village, Southbury, CT 06488

31

A note just received by me at Westfort Island from your hard working secretary **Ed Worden** asks me to fill in while he's away, so here goes.

Fortunately, we just had a visit from Lillian and **Al Sims,** who were here in Maine visiting a daughter. We were so glad they had a chance to come over and spend the afternoon with us. It was the first direct report we'd had of the May mini-reunion on the Mississippi River which Louise and I couldn't make. Al reported that they had a great trip.

Had a nice note from **Randy Binner,** our class president, offering to help in any way he can and I warned him that **Dick Ashenden** and I will surely be counting on him in our plans for the 60th. In fact, we'll be looking for suggestions from the whole membership.

Only two notes this time concerning deaths: **Robert L. Parker,** civil engineer, North Reading, Mass., formerly of Worcester, who did postgraduate studies at M.I.T., died in April 1988.

There is to be a memorial service Tuesday this week for **Robert Leadbetter.** He died some months ago but the memorial service was scheduled for this active time in the Juniper Point—Boothbay Harbor, Maine, area where Bob was so well known for many years.—**John R. Swanton,** Assistant Secretary, 27 George St., Newton, MA 02158; **Edward S. Worden,** Secretary, P.O. Box 1241, Mt. Dora, FL 32757

32

Doris (Mrs. **Donald) Gilman** was very pleased with the write up about Donald. She asked for and received three copies of *Technology Review* which she mailed to her family. She says the class of '32 means much to her though her attendance was restricted to weekends.

John (Jack) Struckler, Jr. writes us the following interesting letter: "On March 31st, my wife and I celebrated our 50th wedding anniversary with a reception at our local United Methodist Church, and a festive dinner with our three children and the members of our original wedding party (excluding the best man, who was unable to attend). Then on May 6th, my wife, Billie, and I flew to Buffalo, N. Y., where I was inducted into the Niagara Frontier Aviation Hall of Fame. (We moved from Buffalo in 1956 when I left Bell Aircraft after 22 years to affiliate with the Boeing Company in Seattle, Wash.)

"Buffalo has certainly changed in the past 30 years! The transition from the smokestack industries of Lackawanna to the high-tech companies of today together with the 'make-over' of the downtown waterfront is really impressive. The new, expansive Buffalo campus of New York University is attracting new and vigorous personnel into the area. I understand that the same sort of changes are taking place in Boston and Cambridge.

"In September we plan to visit our daughter and her family in Leeds, England, and also to visit in Vienna with our 'adopted' Korean daughter and her family."

Stanley L. Johnson has moved from Larchmont in order to be closer to his living relatives; a son, three grandchildren, and a great-grandson and he's a tough one! Stanley is happier now than he has been for a long time.

T. R. Morral writes that he has just returned from two months in Spain. Unfortunately, one month was devoted to recovering from a high and low fever. He keeps busy with his hobbies and grandchildren.

The American Society of Mechanical Engineers (ASME) has awarded 41 national engineering awards to 52 individuals in recognition of outstanding service to mechanical engineering. We were pleased to learn that one of our classmates—**Leroy H. Smith, Jr.** received an award for his work in turbomachinery aero technology.

We were saddened to learn that **John A. Finnerty** died in Florida in May 1988. He was our class agent for more than 25 years. He was a U.S. Army major during World War II. He formed has own sales engineering company in 1945, which he operated until his retirement in 1983. He was active in many professional, civic, and social organizations. He is survived by his wife, Dorothy Ann.

Herbert F. Ross died in Naples, Fla., in April after a long illness. I remember him as a basketball player and tennis player. During the 1930s he was ranked eighth in tennis in New England. For 39 years he was manager of the mechanical laboratories of the former United Shoe Machinery Corp. He is survived by his wife Marion, two daughters, a son, and five grandchildren.—**Melvin Castleman,** Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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I trust you all got some pleasure from the July letter sent to all classmates from **Dick Fossett,** your new class president. Be advised that Fossett and the undersigned created the letter, but the Institute printed it, mailed it, addressed the envelopes, and paid for the postage—all in very few days. If you want to thank someone, I suggest a note to Nancie Barber, assistant director, Alumni Fund, Room 10-140, Cambridge, MA 02139.

Dick Robinson has been elected treasurer of the National Stone Association at a Houston meeting. He is still active as president of the Massachusetts Broken Stone Co. at Weston. . . . **Leon Hyzen** is very active as treasurer emeritus of U.S. Philatelic Classics Society. **Steve Rhodes** is still running the "small family business" 55 years after graduation, two daughters, and 12 grandchildren! . . . **Harry Summer,** Evanston, Ill. (spouse, Cele, longtime with Lerner Shops) is now in production control at Rank Video (formerly Bell & Howell) "working for fun."

Obits include **Dick Morse,** who did a first-class job as class president and whose career appears in The October issue, page MIT 52. Fortunately, he and Marian were able to attend the reunion at Chatham. . . . **Larry Hubbard** died last June 15. Mrs. Elizabeth Hubbard is at 10 Mill Pond Lane, Old Lyme, CT 06371. . . . **Newt Beurger** died June 7, survived by Mrs. Esther at 255 Del Mesa Carmel, Carmel, CA 39921. . . . **Fozi Cahaly** died July 2. Mrs. Margaret, his widow, is at 254 Washington St., Belmont, MA 02178.—**William B. Klee,** Secretary, Box 7725, Hilton Head, SC 29938

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May I open with thanks to **George Bull** for picking up on the October issue and some words of sympathy for the loss of his wife, Mary Elizabeth. She has been a faithful reunion-goer, and we will miss her.

Losses and notes come in equal parts this month. Although this one will have to be read in the past tense, **Ed Geittman** writes, "Mary and I are looking forward to attending the 1934's 54th mini-reunion September 13 to 16 at the Basin Harbor Club on Lake Champlain. Hope to see you there." . . . **Tom La Cava** is apparently enjoying the good life, as he notes, "Retired in N. Falmouth, Mass.—gardening and ocean bathing in season. I catch up on studies during unseasonable weather."

Winton Brown is beginning a new phase of life: "Remarried in September 1987 to Elizabeth M. Haynes of Centerville, Va. Moving to Lake of the Woods, Va., in the fall of 1988." . . . **Warren Kunz** writes, "All's well in (just as the natives say) this 'land of pleasant living.' Still having many friends visit by land and water. Come!" . . . **Kenneth Dorman** says, "Granddaughter Nancy Moulton has been accepted at Georgia Tech in aeronautical engineering. I tried to get her to apply at M.I.T., but she is a southerner and does not like cold weather. She may, however, eventually end up at M.I.T. grad school later." . . . **George Woodman, Jr.** tells how he splits his time between the north and the south: "We, my wife Audrey and I, spend six months on Big Pine Key, Fla., and the other six on North Haven Island, Maine (two heavens). As we live in view (400 yards) of Pulpit Harbor, North Haven, we would be delighted to hear from any of our M.I.T. yachting classmates or friends.

On November 10, 1987, **Frederick Parks** died in Chester, Nova Scotia. I have only the notification from his daughter to M.I.T., with no other details about him. . . . **Edward Cook Sr.,** of Plainville, Conn., died March 4. He had received his master's degree at M.I.T., then went on to Stamford to take his Ph.D. He wrote several technical books for education in the engineering field and was a member of several professional societies. Prior to his retirement in 1985, he had spent 25 years with the Dunham-Bush Co. in West Hartford. Cook is survived by his wife Barbara, two sons, two daughters, and three grandchildren. . . . **Kendal C. Ham** died in Conway, N.H., last March 12. Ham had owned and operated Pepsi-Cola bottling companies in Lynn and Conway for 52 years. He has been an active member of Masonic groups in Bridgton, Lewiston, and Fryeburg, Maine, and is survived by his wife, a daughter, and a granddaughter. . . . In May Dr. **Ralph Gross** died suddenly in Belmont, Mass. After getting his B.S. with us, he went on to Tufts Dental School. After serving in World War II as a captain in the Dental Corps, he practiced as an oral surgeon in Cambridge for 41 years, retiring eight years ago. He is survived by his wife, Eleanor, three sons, a sister, and six grandchildren. . . . In June we lost what very well may be the oldest person associated with our class,

Gregory Korjeff, 93, of Fitzwilliam, N.H. He had served as an officer in the Russian Imperial Cossak cavalry during World War I and became a lieutenant colonel in the Russian White Army. After the war, he graduated from the Institute Polytechnique in Grenoble, France, and eventually came to the United States and studied at M.I.T. Mr. Korjeff worked for the Norton Co. in Worcester as a plant layout engineer from 1946 to 1960. He had also worked for I.B.M. and the Navy Department.

Our final loss to report this month is that of **Warren Ford,** on July 5 in Weymouth. He had been vice-president at Jarvis Engineering until his retirement in 1973. Music had been a major interest in his life; he had sung with the Glee Club at Tech, then with the Handel and Haydn Society in Boston, and for many years was a soloist with the church choir of the Union Congregational Church of Weymouth and Braintree. He had also been active in several Masonic organizations. Mr. Ford is survived by his wife Emma, three sons, a brother, and four grandchildren. . . . To the families of these past members, I offer condolences on behalf of all of us.

A note from **Phil Kron** shows that he still stays active with other class members. He says, "We had a mini-mini-reunion last July at Lighthouse Point, Fla. Present were: Thelma and **Gil Lorenz**, Jeanette and **Ernie Massa**, Jean and **Dick Sanders**, Margaret and **Saul Jacobson**, Ellie and **Phil Kron**, and **Bob Moody**. The reunion consisted of lunch and a social hour at the Lighthouse Point Yacht Club. We strongly recommend other min-reunions in various parts of the country." By the time this is in your hands, we will know how successful the September effort was at the Basin Harbor Club in Vermont.—**Robert M. Franklin**, Secretary, P.O. Box 1147 (620 Satucket Rd.), Brewster, MA 02631; **George Bull**, Assistant Secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

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Hooray for another first-time letter. This one from **Joseph K. Rees** from his home in Las Vegas, Nev. "It's about time I wrote something to you. Fortunately there is something pleasant to write about. Lillian and I celebrated our 50th wedding anniversary on June 10. The affair was held at Sportsman's Lodge in Los Angeles. Although we live in Las Vegas, many of our friends and relatives live in L.A. My daughter Jill and son Ronald ran the affair. It was a most difficult chore for them because Jill lives in Alaska and Ronald does a lot of traveling on his job. However, everything was planned beautifully. Shortly after the affair we planned a trip to Portugal, Spain, and Morocco. Around that time, terrorists highjacked a plane and killed two passengers. The company postponed the trip until August, so we are still looking forward to it." Joe closed with words of praise and said he would see us at the next M.I.T. affair.

Samuel P. Brown, commenting on my forthcoming move to San Diego, writes that having been at Coronado Island as well as the mainland in both wintertime and August that I am sure to like the climate there much better than in Boston. He says it's lovely, sunny, and warm in winter and August is never really hot. He wants to be sure I let all '35ers know my address and phone as soon as I get established.

Sam also said he had a splendid trip in Europe, leaving Paris on May 14 in their new Renault 5-GTS. They drove about 3,860 miles in the 31 days they had the car. On May 25 they had dinner and stayed overnight with the Demonchy family, with whom their granddaughter had spent July 1987. Sixteen-year-old Cecile Demonchy is spending August at the Browns' daughters' home in Fairfax, Va.—an example of Eisenhower's "people to people" program. Sam says the toll rate on the Italian and French toll roads are more than three times that on the N.J. and Mass. turnpikes but are surely worth it. On all the Austrian and German Autobahns the speed limit is 130 Km (81 mph), and the "locals" often roared past him at 95 mph. Says Sam, "I admit I often thought, 'What is a 75-year-old American doing here driving this small car 80 to 85 mph!'"

I have to report the deaths of two former classmates. **Robert A. Scribner,** M.D., died June 10 at the Huggins Hospital in Wolfeboro, N.H. Bob went to Harvard Medical School after M.I.T. and graduated there in 1939. He spent four years in the Pacific Theatre during World War II, serving as a colonel in the Evacuation Hospital. He was a surgeon in Reading, Pa., before joining the staff of the Veterans Administration Hospital in Manchester, N.H. His widow, Mary-Lou, lives in Highlands, N.C. . . . **Robert Goodman** died June 30 in Winston-Salem, N.C., where he and his family lived for the past 17 years. Bob was an aeronautical engineer for Fairchild Industrial, and researched propulsion with Werner von Braun, the German rocket engineer. He lived in Stamford, Conn., for 31 years before moving in 1971 to Winston-Salem, where his widow, Doris, lives.—**Allan Q. Mowatt,** Secretary, Box 524, Waltham, MA 02254

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Time for the second leg of our odyssey—beginning April 28 from Florida north to New Jersey. In Naples, **Bob Caldwell** and Sara were about to leave for two weeks in Puerto Rico and then on to Sudbury, Mass., for the summer. He is still active in California Products, Cambridge, which he joined in the mid-1950s when the company was developing an acrylic coating for tennis courts. It grew to be one-quarter of the total company output, and he grew to be CEO. Bob joined us after four years at the University of Virginia, and was joined in junior year Course VI-A by another Virginian, **Charles Hobson** (more later). . . . Next en route, after missing **Mal Holcombe** in Naples, was Punta Gorda. **Harry Easton,** Course II, retired in 1977 from General Foods Corp., where he was operations executive at its White Plains, N.Y., headquarters. Since then he has kept active with power boating and much travel, including Alaska, where he was posted during the war.

Next, a batch of no-answers (gone north for the summer?), but we saw **Ed Nicholson** and Betty in Sarasota. He is retired from Exxon Research, and was about to leave on a trip north to visit family and friends, anticipating a larger reunion in August with family from Holland and Illinois. Since our 50th reunion, Ed and Betty have traveled extensively in East Europe. He is one of the Course X-A contributors to **Bill Rousseau**'s annual roundup of letters, mentioned in the October Notes. . . . Then inland to Atlanta. On a Sunday afternoon **Bill Bode** and **Lou Young** were too busy with family activities for visits, but over the telephone Bill told of his second retirement in March from Selig Enterprises. He had retired as executive vice-president from Selig Chemical in 1978, and was called back as an in-house architect. Now, in his basement woodwork shop, he crafts colonial furniture reproductions, using the machine-shop and forging skills that were required of Course IIers in our day. He exhibits at arts and crafts shows in and around Atlanta and does a thriving business. A grandson who Bill and wife Ella raised is now in college, and another grandson is in Little League. Bill was managing the team in one game and umpiring another game that same afternoon we called. He and I reminisced about our busy but great days as student waiters in Walker Memorial under that prince of directors, and Southern gentleman, Bill Carlisle '28.

Lou Young was back at the Institute two years after graduating, teaching quality control, math, and economics and earning his master's. Later his career included U.S. Steel, Lockheed, and more time at M.I.T., specializing in heat treatment of steel and other manufacturing and operations research. He wound up with 14 years on the faculty of Georgia Tech, retiring in 1974. He suffers from emphyzema, but is up and about. . . . In nearby Peachtree City we visited **Roman Ortynsky** and Bernadette. Ro went from Course X-B into Shell Chemical and then a great career in Army Ordinance: several patents, appointment to the Chemical Corps Board, etc. He new Bill Creasy, who as major general was chief of the Corps. Ro has a collection of *Techniques* that he won in the annual undergraduate "rushes"—free-for-all skidaddling up a greased eight-foot-high hut to the roof, where tokens were handed through a hole at odd intervals. Ro had a sure winning technique, being light enough that his friends could *throw* him up. **Joe Chenette** and **Roman Ulans** will remember. Another heaver was **Roger Le Blanc** (deceased 1981).

On to my brother's home in South Carolina and a few days of R&R and leg stretching. Then over the Smoky Mountains on the White Horse Pike to a lunch with **Charles Hobson** and **Bob Hunt** in Knoxville. Charlie told how he and **Bob Caldwell** needed each other to graduate in Course VI-A. Bob was a speedy note taker, but had trouble deciphering them afterwards. So Charlie listened only, and later interpreted. In World War II the Navy sent him to Oak Ridge to help with the bomb, and later, in peacetime, he bid on a portion of a construction contract there. At the start he had two bricklayers working his portion. At the end he was doing the entire contract, with 50 workers. Bob Hunt joined him as vice-president, and they were able to work together in harmony for 40 years by agreeing on their contract bids and sticking with them, with no second-guessing later. Bob came to Course VI-A with an S.B. from Clemson, and was at General Electric in Pittsfield, Mass., and Schenectady, N.Y., for two of his three terms while getting his master's. In the war he was assigned to anti-submarine warfare, operating from Puerto Rico and the Virgin Islands.

Back to Asheville, N.C., and a visit with **Stan Johnson.** He recalled a post-graduation period in Pittsburgh when his senior-year thesis partner **Wally Mathesius** was with Koppers and Stan at U.S. Steel and they got together for occasional lunches. (The thesis topic had been suggested by the head of research at Steel, and I surmise he liked the product. Incidentally, Wally found a steno to type it at 15 cents a page.) Stan is president of a men's garden club that sells plants at a farmer's market, with profits going to beautify Asheville and the University of North Carolina Botanical Gardens. Men are outnumbered ten clubs to one in such an endeavor, but no matter, enthusiasm does not suffer. . . . In Charlotte, **George Crummey** harked back to Coach "P.T." McCarthy and the basketball teams George managed, which included **Bill Wu, Fletch Thornton, Bill Garth,** and **Chuck Kennedy.** After an initial spell with G.E. and mercury arc rectifiers, George went into specialty steel sales and management with Wheelock Lovejoy & Company in several locations, the last being in Charlotte. Wife Grace has an exquisite collection of buttons. They traveled in Ireland for 10 days last August and not a drop of rain! In earlier years they spent three-month periods in Brussels with a daughter. (Our travelogue will continue in next January's Notes.) . . . The *Maui News* of Hawaii May 4, under the heading "A Chairman for All Seasons," asked "What do several distinctive Maui organizations have in common?—**Robert Wead**." The article goes on to list six organizations of which Rob is chairman, president, or vice-president, concerned with mental health, senior affairs, etc. He also teaches self-hypnosis at Maui Community College, the AARP defensive driving course "55 Alive," and on and on. This all started after 40 years in industry with a move to Hawaii and a new career. Rob has been nominated for "Outstanding Older American of Maui." Congratulations, Rob! and I hope to see you next year.

And a cheer for the life of **Herbert Sturgis Potter,** who died July 15, 1987, still dauntless after many years of ill health. "Sturg" left us sophomore year to run the family electric construction business in Boston after his father died. When contracts dried up in the depression, Sturg took a job with Carpenter Steel and progressed to vice-president, Domestic and International Relations, retiring in 1972. He continued some of his many interests, which included hospital and bank boards, music, woodworking, tennis, golf, and sailing. His widow (RD #1 Sheerlund, Reading, PA 19607) conveyed to me her warm pride in his useful and productive career. . . . **Donald Henshaw** died November 9 last year. Don was with us only one year, a victim of the depression, but he started a sheet-metal business in Pawtucket, R.I., later another in Providence, and also manufactured badges as a sideline. He was interested in education, was president of the Humanists Society, and ran for local and state offices. Some 25 letters to his widow (99 Wilcox Ave., Pawtucket, RI 02860) told of his good influence on the writers. . . . In her words—"A wonderful husband." . . . **Walter Lane,** Course XV, died last December. He had been senior engineer with Bethlehem Steel Shipbuilding in Quincy and later at Sparrows Point, Md., retiring in 1972. He saw his son John W. graduate from the Institute in '73. His wife, Frances, is at 135C Versailles Circle, Baltimore, MD 21204, when not visiting their seven children and 11 grandchildren.

John Hamilton, Course XIV—electrochemistry, died June 28. He had retired from Union Carbide after many productive years on pioneering projects—one on silicones went from pilot plant to full production and took Jack to West Virginia. Later he was at company headquarters in New York and lived at Old Montauk Hwy., Amagansett, NY 11930. Active at the Institute in soccer (captain), track, M.I.T.A.A., Dorm Committee, and Tau Beta Pi, Jack is remembered as a handsome and pleasant classmate. His widow, Harriet, told **Pat Patterson** that Jack held his own against Parkinson's disease for more than two years, but then declined rapidly and developed pneumonia. . . . Also deceased are **Robert Hannam** and **Marvine Gorham,** both of Course XV and both on June 15. A note from Bob's wife, Betty, to Pat told of their exciting and beautiful life together for 39 years, and of his joy at being at the 50th reunion (notwithstanding an impaired gait from an earlier stroke.) Bob ("Buck" as an undergraduate) got his master's at Columbia in international administration and had experience in naval government in Guam and in export business in San Francisco. Before U.S. Senate committees he advanced causes dear to our hearts: preparedness, prudence, tax reform, etc. . . . **Gus Gorham** was, until the day he died, manufacturers' representative in Los Angeles for Buffalo Forge Co.—a happy relationship of about 50 years. Readers may remember a January Notes' mention of his TV appearance concerning a T-Bird he had driven 470,000 miles, as reported to me by **Bob Lutz.** (Marv's sister Ellen Motter thinks that that figure for the '57 model is actually 700,000 miles.) Shell Oil heard about Marv and his car through Marv's local gas stations, and featured him in a 30-second nationwide commercial. **Connie Bouchard, Gordon Thomas,** and members of Number Six Club—did you see it? Marv's widow, Margaret, continues at 505 S. Westgate Ave., Los Angeles, CA 90049.

A news clip of an obituary for **Warren Sherburne** came to me from **Ed Rowe.** "Sherb" died July 8 of brain tumors that had been under treatment about 18 months. He and Ed were both Course XIII, worked for a few years at Newport News Ship, and years later in retirement sailed together on Long Island Sound a few times. Boats were Sherb's life: some 29 designs for Blount Marine in Rhode Island, ship design and floating nuclear-power-plant projects at Electric Boat in Groton, and sailing for fun in the family sloop on the Sound and around Cape Cod. He and wife, Mare', traveled widely (by freighter to Europe and the Far East), and he delivered boats he had designed to New Orleans and Venezuela. Mare' stays on at 9A Churchwood, Niantic, CT 06357. . . . And a news clip via **August Mackro** tells of **Kenneth Packard**'s death June 27 of a heart attack while working on his home at 200 Castle Dr., Stratford, CT 06497. Ken's career in steam turbines and electric apparatus was with Westinghouse, where he also took graduate training. He instructed at the Bridgeport Engineering Institute, chaired a renovation drive, and was a trustee of his church. His widow, Suzanne, who has two sons and four grandchildren nearby, said that Ken's health was good to the last day, and his quick death was as he would have wanted. Let's make a toast in tribute to all these sterling classmates and their contributions to society and the economy.—**Frank L. Phillips,** Secretary, 901 Los Lovatos, Santa Fe, NM 87501; **James F. Patterson,** Assistant Secretary, 170 Broadway, Pleasantville, NY 10570

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Gray Jensvold is semi-retired as chairman, The Vermont Co. He is "pretty well crippled with Parkinson's Disease and unable to walk more than a few steps." However, any classmates near Stowe, Vt., are invited to telephone and come for a visit; he is in the area telephone book and would be delighted to see any visitor. . . . **Jo Smedile,** 3579 Admirals Way, Delray Beach, FL 33483, says, "We have had lots of wet weather here and, surprisingly, the temperatures have been more equitable than up there (Boston) and the Midwest. We have been kidding our northern friends that they should change their basic plans and come to Florida in the summer, when it is cooler.

Jerome E. Salny, P.O. Box 304 Fairlawn, NJ 07410, writes, "Life goes well. Abbie's and my health are pretty good. We have enough to do what we want to do, plus a $10 bill (my definition of rich). After a business lifetime of combining itches with niches, I have thinned out everything except for one tiny business to keep me active. This is dream fulfillment time—kissing the Blarney Stone; looking out to the North Pole from the north Cape and to the South Pole from Hobart, Tasmania; Club Med annually; China twice; Australia and New Zealand twice; Europe inumerable times. We have a small apartment in Paris, which we visit half a dozen times a year, sometimes as a focal point for Madrid, Florence, Venice, etc. Have piloted our own (rented) boats down the canals of France several times and took the shots in Switzerland. Our social center is Mensa, and we have Mensa friends all over the world.

"My biggest excitement is from my wife Abbie. After retiring as a full professor and deputy chairman (sometimes acting chairman) of the Psychology Department of Montclair State College, she embarked upon a writing career, as a writer of quizzes and puzzle books. Seven are out (some being sold in the M.I.T. bookshop), and the eighth is in the typewriter. She is supervisory psychologist of American Mensa and World Mensa (and I always add—unpaid). And she invented the first completely wordless, self instructing, and self-scoring IQ test. We both had a great time at the 50th reunion and look forward to our 55th.

I regret to report the death of **Walter Haight** of Scituate, Mass., who died last June 8 at South Shore Hospital in Weymouth. He is survived by his wife, Barbara M. (McKown), a son Stephen of Marshfield, a daughter Jane H. Penza of New Jersey, and five grandchildren.—**Lester M. Klashman,** Secretary, 289 Elm St., Apt. 71, Medford, MA 02155

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Last month's notes named five of our classmates who submitted biographical sketches too late to be included in the 50th Reunion Class Book. So here they are in abbreviated form:

Russell (Russ) C. Coile, S.B. and S.M. in electrical engineering and Ph.D. from City University of London. Spouse, Ellen; three children. Currently, senior scientist for Evaluation Technology, Monterey, Calif. Following M.I.T.: geophysicist in Magnetic Observatory in Peru; Signal Corp in Washington, D.C., to grade of Captain; operations research, respectively: in M.I.T. administered U.S. Navy's Operations Evaluation Group, Franklin Institute, University of Rochester, Ketron of Arlington, Va., and Fort Ord Planning Research Corp.

Nathan (Nate) Einis, S.B. in chemical engineering. Spouse, Florence; three children, five grandchildren. Since graduation: three years in the U.S. Army and in plastics business and 35 years in construction.

Lloyd Ewing, S.B. in management. Spouse, Margaret; four children, eight grandchildren. Since graduation: four years each as project engineer and in the U.S.Navy; 42 years with Ewing Engineering Co. (president).

Albert (Al) W. Minott, S.B. in management. Spouse, Janet; one child. Occupation: pre-World War II, occupational research; World War II, U.S.Navy; post-World War II, aeronautical engineering for 24 years with FAA, Douglas Aircraft and Hughes; then switched to electric power utilities.

August (Russ) T. Rossano, S.B., chemical engineering; S.M. and Sc.D., Harvard. Spouse, Margo: eight children, 11 grandchildren. Following M.I.T., Russ (Gus, as we knew him then) earned his S.M. and Sc.D. degrees at Harvard in '41 and '54. For 22 years following his master's, he served in the U.S. Public Health Service as an engineer—the last three of those years on loan to Cal. Tech. to assist in establishing air pollution and radiological health graduate programs and research. From then until 1981 retirement Russ was professor at the University of Washington in Seattle.

Norm Leventhal's Beacon Companies now have office building and development as far afield as Florida, Texas and California. Yet probably none has had such acclaim as his magnificent waterfront project, Boston's 50 Rowes Wharf—which, incidently includes the company's new quarters.

This fall, Boston's financial district, site of eleven of the city's newest office towers, will see the initial work on a $71 million unique project—a combination of downtown park and a 1,400 car underground garage. For three years a concerned group, The Friends of Post Office Square, has worked to replace the present blight at that site by an open space park which can add a focal point for the financial district. President of the Friends (which include representatives of Bank of Boston, Shawmut Bank and Fidelity Investments): none other than Norm.

Another classmate has moved to Maine. In early August Ruth and **Paul Black** moved from their home of 28 years in Sudbury, Mass., to a new condominium in Maine, overlooking the Damariscotta River. Nearly three decades in one house is a distinct contrast to the 14 moves of their first 20 years of married life. They hope classmates who are in the vicinity of Damariscotta will stop for a visit at their new address: Apt. 403, Schooner Cove. Their first guests, the Severances, enroute home from Nova Scotia had lunch with them the day after the movers had deposited their furnishings, including more unopened packing boxes than we could count.

Phyl and I are seeing Alice and **Roy Hopgood** frequently at our respective cottages on Lake Winnipesaukee, N.H. Since our Cambridge reunion they attended Alice's 50th at Wells College and a week later embarked on an extended business/pleasure trip to Germany and the U.K. They spent two weeks on a Williams College cruise, visiting many interesting ports in England, Scotland and Wales, including the Channel, Shetland, Hebrides, Mull and Scilly Islands. For years, Hoppy has represented the patent interests in the United States of the famous Carl Zeiss Company

as well as several other European entrepreneurs.

From **Ed Hadley** we learn of the death in Florida over a year ago of **Arthur L. Livingston.** Arthur, who attended M.I.T. only a year, spent virtually his entire professional life in Panama with the U.S. Panama Canal Co. and in his own contracting business.

From Rosalind Cusack, daughter of classmate **Ralph E. Hughes,** we learned of his February passing too late to include in the In Memorium dedication of our Class Book. Our deepest sympathy to Mrs. Cusack and others of his family.

Finally, at our class meeting at Chatham Bars it was agreed we should continue our series of mini-reunions. Anyone not at one of the recent ones and who might possibly be able to join us next June, do have me add your name to the mailing list. The date, Friday, June 9, 1989, the evening of Technology Day. The place, M.I.T.'s lovely chateau in Dedham, Endicott House. Incidently, there is a limited number of bedrooms for early registrants from out of town.

That's all there is until you send us more news.—**Don Severance,** Secretary, 39 Hampshire Rd., Wellesley, MA 02181; **Ed Hadley** Assistant Secretary, 50 Spofford Rd., Boxford, MA 01921

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Jim Barton served two years as councilman and then 20.5 years as mayor of Hunts Point, Wash. He retired and was honored for his outstanding services during the August town meeting. How many other '39ers have served their communities consistently and splendidly for 22.5 years, and without pay? And how about Mary Barton who helped all these years? Vignettes like these stimulate admiration, and classmates can feel appreciation and bask in the glow of reflected glory created by Jim and Mary.

Marjorie and **Phil Buash** are traveling in Russia. They expect to be in Moscow and Leningrad for five days each, plus ten days going down the Volga and Don rivers. Phil relayed news of the death, during March, of **Ernest Schlage.** Before his retirement, Ernest was vice president of research for Schlage Lock Co., a division of Ingersoll Rand.

Robert Plunkett, P.E., professor of aerospace engineering and mechanics at the University of Minnesota, was named by the American Society of Mechanical Engineers to receive the honorary membership award for a lifetime of service in engineering. . . . Connie and **Manning Morrill** and Ruth and **Jim Laubach** were recognized in full-page pictures in "Donor's Profiles" in recent editions of the *Review.* . . . **King Cummings,** former president of Sugarloaf Mountain Corp. and chief executive of Guilford Industries, was nominated by Governor John R. McNernan to the board of trustees of the Maine Maritime Academy.

We are saddened by a *Los Angeles Times* report of the death on May 9, 1988, of **Norman C. Chase** of Palm Desert, Calif. There were no details.—**Hal Seykota,** Secretary, 1701 Weatherswood Drive, NW, Gig Harbor, WA 98335

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A note recently arrived from **Antonio Arias** in Madrid, Spain, requesting the addresses of **Charlie Maak** and the widow of **Given Brewer.** Tony did not supply any information about himself. Perhaps he will respond to the addresses with some details of his activities.

A long letter from **John J. Casey** of Port Washington, N.Y., tells of his retirement as chairman/CEO of Pan Am Commercial Services, a subsidiary of Pan Am Corp. This position involved many trips to the Pacific Basin and to the Peoples Republic of China to establish a satellite communications international joint venture. He goes on, "During this past year, we also worked out a program under *glasnost* for a joint venture between Aeroflot and Pan Am wherein a 747 operates nonstop between New York and Moscow/Leningrad three times a week. The Pan Am half of the aircraft is running a 90 percent load factor. In fact, that is the best way to go to the Soviet Union these days.

"In July, I formed my own aviation consulting organization, John J. Casey & Associates. A number of proposals have been submitted, but no billable accounts as yet. I attribute this to: hot weather, flat stock market, vacation time, and a presidential election. . . . not me, of course.

"One last item: I accepted the general chairmanship for running the Scout Show on April 1, 1989, for the Greater New York Councils. It will take place on three piers and the *Intrepid* on the Hudson River side of Manhattan. It should be the biggest (and best) Boy Scout event ever held in this country as well as contributing beaucoup funds for youth of the five boroughs of New York City. Please come!"

Beano Goodman writes from Madison, Ind., "I'd like to report on on interesting second career. **Dick Braunlich** retired to Vero Beach, Fla., about seven years ago and concentrated on what had always been a hobby. He had played violin (both jazz and in string quartets) for years, but only recreationally. He also played guitar and vibrophone. Since getting to Vero, he's concentrated on jazz violin and has gotten to be one of the top artists in the country. Dick works mostly in the Vero area and has a cute gimmick going which gets him two payoffs for one night's work. He first plays during cocktails and dinner (at a fancy party) string quartets with three ladies from the Palm Beach Symphony. Then the ladies go home and he brings in three or four jazz guys and plays for the dancing which follows dinner. Great idea! He was passing through here, so we had him play at a party at the local club. I got a piano and bass for him and the music was superb. Dick knows every piece anybody has ever heard of and the night was highly successful. . . . It was a wonderful evening.

"I'm just starting to try to play a little tennis, so the leg is slowly coming back. The hip is great, but I do have some residual deadness in my foot, which inhibits running. But I never was very fleet of foot anyhow."

A brief note from **John G. Burr:** "Became Professor Emeritus of University of Oklahoma in 1986. Retirement is great! Golf and travel plus some free-lance science/religion writing."

Unfortunately, there are some deaths in our class to report this month. **Kendall C. Valentine** died April 2, 1988 at Hartford Hospital. He lived in South Glastonbury, Conn. He retired in 1976 from Pratt and Whitney Aircraft, East Hartford, where he was employed for many years as a design engineer.

Schrade F. Radtke of New Canaan, Conn., died on April 9, 1988. He leaves a son, Mark Lane Radtke of the class of 1973. Schrade was president of the International Lead Zinc Research Organization, Inc. (ILZRO) until his retirement in January 1984, when he became president of his own consulting firm, Cosmos Engineering. His successor as president of (ILZRO) said that "Dr. Radtke had a major impact on the lead and zinc industry, particularly in alerting it to the importance of cooperative product and process research. Starting from scratch, Dr. Radtke built ILZRO into an organization with a worldwide reputation for sound research and development. The industry is reaping benefits today in such areas as die casting, galvanizing, batteries, and environmental health, among others. His contributions in these areas will be his everlasting memorial."

Divo Louis Tonti of Holmdel, N.J., passed away on June 5, 1988. A local news item about him states, "He had been executive director with the New Jersey Highway Authority at the Garden State Parkway from 1954 to 1971, when he retired. Mr. Tonti directed the planning, construction and maintenance of the Garden State Parkway, and was in charge of the overall planning of the state highway system, directing a staff of 1,300 personnel. He directed the construction of the Cultural Center, the Garden State Arts Center and the Bond Financing Programs for the state highways."

The class sends its deepest sympathies to the bereaved families.

Keep those letters coming.—**Richard E. Gladstone,** Secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

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John Bertil Waller died in May 1988 at home after a two-month illness. He was president and treasurer of the A.E. Waller Co. until retiring in 1985. He lived in Cranston, R.I., before moving to Barrington in 1955. After M.I.T., John served as a naval officer in World War II. He was a member of the American Society of Metals, the Manufacturing Jewelers and Silversmiths of America and the M.I.T. Club of Rhode Island. He was also a member of the Edgewood and the Barrington Yacht Clubs. At M.I.T., John was a brilliant student, four times on the Dean's List, studied metallurgy, did a lot of sailing, was a member of the Outing Club, and played three years of hockey and one year of lacrosse. Beside his wife, Margaret, he leaves two daughters: Jean L. Waller of Annapolis, Md., and Kristin C. Waller of Boston.

Norman Irving Shapira died March 22, 1988. At M.I.T., he studied business and engineering administration and was active: Field Day marshal, Junior Prom Committee, Senior Week Committee, Advanced ROTC, Chemical Warfare and Commuters Club, Outing Club, *Technique.* He was a colonel in the U.S. Army and retired from hydronautics. He lived at Prince Fredrick, Md.

Please send a note—anything at all—to your secretary.—**Joseph E. Dietzgen,** Secretary, Box 790, Cotuit, MA 02635

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Got a letter, a postcard, and a very flashy business card done in an arresting fluorescent orange from **Charles E. Ruckstuhl,** Inc., Technical Marketing, Groton, Mass. Charlie had a successful triple bypass last winter. He and Muriel winter at Vanderbilt Beach, Fla., near Clearwater. Looks as though we'll be able to get a goodly 1942 winter reunion with at least five or 10 classmates in that area. Charles reports that his weight is down to 177 (from 199) and that he feels 35 instead of 70. Sent a picture along to prove all claims!

Fred Gander reports his winter address in Dunedin, Fla., just north of Clearwater. He has visited with Audree and **Jack Altekruse** in Largo, Fla., with Sis and **Donn Barber,** and with Fran and **Bill Strong.** Would appreciate getting current addresses of any of you who are in the Tampa-Clearwater-St. Petersburg neighborhood. . . . Jean and I will be back at Top of the World in Clearwater in November. I'll get a reunion, Rump Class Meeting, or somesuch organized for the late fall or winter.

Bill Steinwachs is retired and he and Frieda are living in Issaquah, Wash. They are enjoying the "pleasant and dramatic change from 33 years spent with Rockwell International in Torrance City, Calif." Both are now involved in city government and community activities with time left for traveling to distant places. . . . While in the "distant places" mode, another great newsy letter from our Australian correspondent, **Charlie Stempf.** As all who know Charlie will understand, much of the letter is not suitable for publishing in a family-type magazine such as *Technology Review.* We've been corresponding about many vital matters including computers and word processing. He has a taiwanian clone of a PC with First Choice Software (same as mine), and comments that these items are available, "even in a primitive country" (New South Wales, that is). Charlie opines, finally, that nothing will ever take the place of his "log-log decitrig

slide rule with a magnifying hairpiece." I think he's referring not to a "rug" but to the hairline magnifier.—**Ken Rossett,** Secretary, 191 Albemarle Rd., White Plains, NY 10605

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We must sadly note the passing of two classmates: **Mark W. Cauble,** Atlanta, Ga., March 30, and **A. Donald Moll,** St. Paul, Minn., April 15. We extend our condolences to their families.

Bill Thurston has hit the news again. Bill received the 1988 ATE & Instrumentation Conference-East John M. Fluke, Sr., Pioneer Award for his lifetime achievements and contributions to the test and measurement industry and the engineering profession. This report comes from **John Ward,** who also says that he finally retired from M.I.T. in 1977 after 40 years on the job. He will stay in Lexington, Mass., keeping busy with long-deferred projects around the house, various town committees, and a little travel. He spends some of his summer at the Ward family beachfront cottage on Lake Erie, near Toledo.

Now for more reunion news. The Gang of Nine (Reunion Committee) did a great job in all departments. We got food, drink, lectures, tours (on bus, boat, and foot), golf, tennis, socializing, and dancing. **Gene Eisenberg** managed to scrounge favors in the form of M.I.T. caps and orlon sweaters. The highlight, of course, was the dress-up dinner dance at the Vanderbilt Marble House, overlooking the beach and Narragansett Bay. I could use an entire column just to describe the details of this mansion, which were told and shown to us by a corps of guides provided solely for our benefit. In the history of our reunions, this was the most luxurious blowout I can recall.



Class President Jim McDonough

At the Saturday evening soiree we were told the results of the election to replace some of our exhausted officers. As president we now have **Jim McDonough**. **Chris Matthew** will serve as vice-president-West, and **Bob Gunther,** vice-president-East. **Bob Rorschach** continues as secretary, with **Hans Walz** returning to the treasurer's post.

In his inaugural address, Jim waxed poetic about gaussian distributions. Some of the spouses got an attack of the MEGOs, but in the end were convinced that no home should be without one. Runner-up **Dick Feingold** declined the offer of equal time on the grounds that the subject had been sufficiently promulgated.

The quintennial statistical study reported the usual incredible correlations between class members' weights, annual incomes, home valuations, gifts to the Alumni Fund, leisure activities, and beverage preferances. According to the treasurer's report, the reunion showed a financial surplus in excess of $7,000. This is just enough for the Executive Committee to have a nice party as we begin to plan for the 50th.

I always feel odd writing the late-fall class notes while the outside temperature hovers around 100 degrees. Nevertheless, Happy Thanksgiving and Merry Christmas.—**Bob Rorschach,** Secretary, 2544 S. Norfolk, Tulsa, OK 74114

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Not very much news this month. Our only note comes from **Thor Stromsted,** who writes that he is still active and enjoying his business, the sale, design, and supply of conveying systems—storage of unit or bulk loads and automated production machines and systems. He finds time to visit his sons in Colorado and California and his daughter and grandson in Mexico as often as possible. He has been widowed since 1978. Thor lives in Mequon, Wis. Keep your eyes peeled for more news on the 45th, which is fast approaching.—Co-secretaries: **Andrew Corry,** 16 Brimstone Lane, Sudbury, MA 01776; **Lou Demarkles,** 53 Maugus Hill Rd., Wellesley, MA 02181

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Quickies from the pipeline include:

Dr. John Bateman, who survived Course II and went on to become an M.D. and assoc. chief of nuclear medicine with the VA Meds out on Long Island, sends regards from Huntington, L.I., noting a slipped vertebral disc from lugging his sloop's dinghy (are you better?) and his attendance at "local active alumni activities." Oh yes, he's bought a "soft dinghy."

Stan Ruttenberg, a veritable "neighbor" in Boulder, announced his retirement as secretary general of the International Association of Meteorology and Atmospheric Physics and becoming chairman of the Panel On World Data Centers (geophysical and solar) of the International Council of Scientific Unions. As I write this, Stan, a Course VIII intellect, is in Moscow on a general meeting of this noble organization. Life doesn't get dull when Stan's around.

That's about it for the "Real-Time" news. From here on it's back to the bio book which miraculously continues to offer up interesting stories of old classmates and buddies. A couple of overlooked Course XVI/V-12 chums cropped up on this latest reading: **Carl Nelson** transitioned into V-12 from the University of Delaware. After getting his stripes, etc., he went back to Delaware for his master's and stuck around to teach there, marry (Dorothy), and sire four boys. Along the way Carl completed his PhD course work in statistics at the University of North Carolina, Chapel Hill. The Nelsons moved south of Pittsburgh where Carl did statistics for Westinghouse. Four years later they decided to move back to Durham, N.C., this time working his magic at the Research Triangle Institute for 14 years. There followed some variations in the field including contracts for EPA. Dorothy died in 1979 and Carl remarried later that year to Pattie. Since then he has returned to academia, teaching mathematics and statistics at UNC, Wilmington, where he and Pattie enjoy square dancing and playing bridge.

E. D. (Dean) Romig took a different route. The night after graduation he married Grace and, after a short honeymoon reported to Quonset Point for a semi-humorous tour of "duty" which ended 26 years later (six of them on "active duty"). Somehow Dean got into electrical design engineering followed by contract building in and around Boston. He phased into consultant work and finally retired in 1984, when the Romigs moved up to Boothbay Harbor, Maine, where Grace runs an antique business in spring/summer/fall, and then they "escape" to their "Florida home near the Gulf" and do some sailing in the Virgins Islands and so forth. . . . Another "R" person I can't believe I've overlooked is **Bob Ritterhoff** who grew up and "prepped" in Baltimore and ended up a XIII Mariner in the V-12 program. Given the option, he declined the active duty following graduation and left the service to marry Vivian and joined the American Engineering Co. in Philly where he "apprenticed" for four years, following by a 15-year stint with Container Corp. With this swell background Bob launched his own building contractor operation in Avalon, N.J., where he passed his next 20 years while living in nearby Cape May Court House (right near where my parents and most ancestors are buried). Anyhow, the Ritterhoffs have three children and a couple of grandchildren who live within short driving distance of "The Court House." A further mild coincidence is the case of **Sherman Naymark** who started out as an Annapolis ensign and went on to a Course XIII SM in our September group. He transitioned into the AEC doing research and development for the U.S.S. Nautilus nuclear power plant and spent some 16 years with G.E. managing nuclear reactor design and development. He formed his own Quadrex Corp. in 1970 in Campbell, Calif., and lives in nearby Los Gatos (where I spent my first 15 married years). Anyhow, Sherman has a list of professional affiliations, publications, and awards "as long as your arm." Next time I'm out there I'll have to check in on Sherman.

My final achiever is **Peter Richman,** unregistered in the technique but powered up for his VI letters, leading to a life devoted to electronics in a variety of ways starting as a grad student at the RLE (successor to the Red Lab), moving on to radio work in New York, followed by design work for a candy company (e.g. a Dentyne Gum inspection machine); a tour with Reeves Instruments, watching with anguish their reluctance to join the solid state world; a stint with Epso Instruments in Boston; finally co-founding Rotek Instruments in Wilmington, Mass. He holds a couple dozed patents, about twice as many papers, and is a fellow of the IEEE. He and wife Vivian, since 1951, live in Lexington and spend as much time off-line as possible at their place on the Cape. Vivian is a recognized artist in metal and plastic sculpture, and their son and daughter are partners in their real estate firm, among other ventures.

Some very belated news of **John Osborn's** demise, a year and a half ago, in Puerto Vallarta, Mexico. Jim was yet another XVIer, apparently retired from Lockheed Missles and Space Co.

Hiking friend **Dave Longmire** just called to relay some sad news about **John E. Taylor** (the St. Louis John Taylor) who passed away in June of a heart attack. He had had multi-bypass surgery in 1986, but evidently just couldn't make it through the rain. John and Dave prepped together at John Burroughs School in St. Louis, and John went on to join us V-12ers. He got his Course VI letters with us and after that brief active duty returned to the University of St. Louis Law College where he got his Law Degree in 1948. He got into patent law, first with the Haynes firm and then with Sutherland & Colster. In 1959 he founded his own patent law firm. He was unwed and managed to retire some 20 years ago. John spent his time hunting and running retriever dog trials.

That about wraps it up. Have a Happy Thanksgiving and a Merry Christmas, and at the very least—DROP ME A CARD!! —**Jim Ray,** Secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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Leonard Winship is owner and president of Ice Cream Creations—they design, create, and cater desserts. (No word on sample availability!) . . . **Robert Marks**, Washington, D.C., has been named director of the American Chemical Society's newly-created Publications Division. He had held the same position for the American Institute of Physics. . . . **Kermit Greene** is president/CEO of L&CP Corp., formerly a division of St. Regis Paper Co. Kermit lives in Newton Center, Mass.

Yours truly recently joined **Larry Michel**, Du-

PHOTO: DICK FEINGOLD, '43

ane Rodger, '48, Dave Babb, '48, and Don Lea, '48, and wives for a mini-reunion at the Avalon Inn in Warren, Ohio. All of us had lived together at the Student House. Larry is seriously considering early retirement and dividing time between Connecticut and the south of France.

We have notices this month that two classmates have passed away: **Leslie Merrill** of San Diego and **Robert Smyth** of Bloomfield Hills, Mich. Bob held many patents relating to truck transmissions.

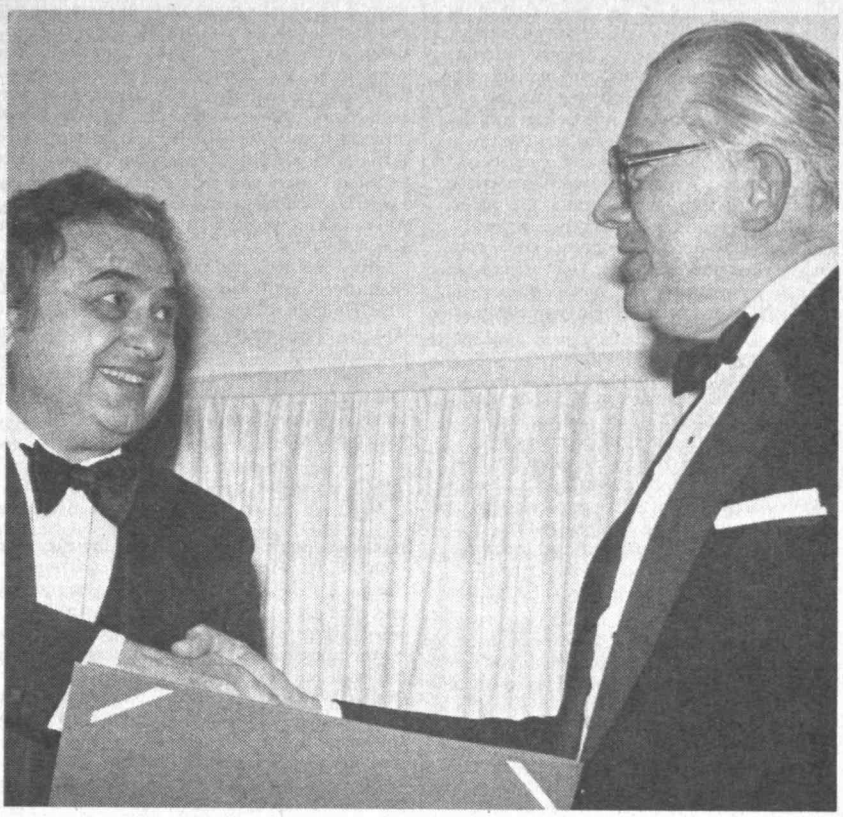
This is my first effort as your class secreatry, so please let me state the "policy of this administration": *please send news.* I promise that whatever is sent will be reported. If any of you have sent news in the last year or two that was not reported, please do it again! (We do not have any material that was sent to my predecessor.)—**Robert E. McBride**, Secretary, 1070 Pilgrim Pkwy., Elm Grove, WI 53122

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By the time you read this, our 40th Reunion will be history. I will avoid the temptation to write a fictional account of the great reunion we had on the M.I.T. campus in October; the time that I write this is August 21st.

Graham Sterling's responsibilities at Analog Devices include working with the M.I.T. Industrial Liaison Program. Analog Devices is a supporting member of the Program. Our classmate **Carl Accardo** is a member of the M.I.T. Industrial Liaison Program. Carl made an official visit to Analog Devices, and after that meeting he chatted with Graham about his family. Carl has six children between ages 21 and 31, of whom five still live at home, when not away at college. Carl's oldest son is a stock broker. Two of his other children have launched a highly successful nationwide fad—sweat pants with interesting multicolor silk-screened designs. They have leased a small factory in Woburn, Mass., and are currently working 16 hours per day, six days per week, trying to keep up with the overwhelming demand. With their customers from all over the United States, they are beginning to encounter the bad debt problem faced by every growing business. . . . **Bill Zimmerman** was elected a trustee of Pine Manor College, a four-year liberal arts college for women located in Chestnut Hill, Mass., five miles from downtown Boston. Bill and his wife Eileen have a daughter, Amanda, who is a member of Pine Manor College's Class of 1991, and two other daughters who are alumnae of the College. Bill is also a trustee of The Los Angeles County Museum of Natural History, and a trustee of Harvey Mudd College, an engineering institution. Bill's firm, Zimmerman Holdings, Inc. owns and operates a number of businesses.

Bob Wofsey and his wife Marcia enjoyed a visit to M.I.T. to be brought up to date on the Institute's newer programs. They are planning to visit Australia, New Zealand, and Taiwan in the fall. . . . **Arnold Smith** completed 25 years with GE in May. He is considering retirement but has not set a date. His wife Marje retired in September 1987. They are building a log home in the foothills of the Pocono Mountains. Their homesite is on a bass-filled lake which Smitty helped build ten years ago. He is on the Board of Scotch Valley Estates which controls the area. He is also on the Board of the M.I.T. Student House, Inc. Later on, he and Marje plan to divide their time between Florida and their home in Scotch Valley. Marje had worked for Dean Harrison in the Spectroscopy Lab in Building 6 during 1947-1948. She is President of the Wilson College Club of Philadelphia. . . . **Len Stutman** continues his active involvement in several areas. His eldest and youngest sons graduated from M.I.T. and have formed Metriplex, Inc., a telecommunications company specializing in software and hardware. Len is consultant in medical affairs to the company which is located in Cambridge. Len is associate professor of medicine at New York Medical College and chief of the Coagulation Research Laboratory at St. Vincent's Hospital and Medical Center of New York. He is medical director for two life insurance companies.



George M. Keller, '48 (right), chairman and chief executive officer of Chevron Corp., is the 1988 California Industrialist of the Year. A blue-ribbon panel of business leaders assembled by the California Museum of Science and Industry made the selection, citing Keller's role in the $13.3 billion acquisition by Chevron of Gulf Oil Corp. and his work as chairman and director of the American Petroleum Institute. "The entire state has profited because of Keller's aggressiveness and foresight," said the award's sponsors. Giving Keller his prize: Marvin Holen, chairman of the Executive Committee of the museum's foundation.

Bill Thorbecke is chairman of Energy Support Services, Inc., which is based in Pittsburg, Pa. Bill was named "Emerging Business Entrepreneur of the Year" in the tri-state area (Pa., Ohio, and W. Va.) by *Venture Magazine.*

Frank Heger was honored with the American Concrete Pipe Asssociation's Award of Special Merit. The award recognizes Frank's many years of research in concrete pipe, which began while he was a member of M.I.T.'s civil engineering faculty in the 1950s. Frank has researched the structural behavior of reinforced concrete pipe, box sections, and prestressed concrete pipe. Frank has been responsible for the design of such landmark dome structures as the 250-foot-diameter geodesic dome of the U.S. Pavilion at Montreal's Expo '67 and the 160-foot-diameter geodesic sphere of the Spaceship Earth theme pavilion at Disneyworld's Epcot Center in Florida in addition to other large concrete domes. He and an associate received an award for their research paper on the buckling resistance of thin concrete domes. Since founding Simpson, Gumpertz and Heger with two other M.I.T. professors in 1956, Frank has supervised research and developed new design procedures using computers for analysis and design. Frank indicated the results have yielded substantial savings in reinforcing steel and enabled them to predict the behavior of cracked pipe fairly accurately. The firm has grown to 115 employees in two locations. Projects range from structural design of major facilities to restoration of historic buildings and installation of radar antennas, radio telescopes, and other long span structures.

Ken Wiberg, Whitehead Professor of Chemistry at Yale University, is the 1988 recipient of the American Chemcial Society's Arthur C. Cope Award. The Award recognizes outstanding achievements in the field of organic chemistry and consists of a $15,000 prize, a gold medal and an unrestricted grant-in-aid of $25,000 for research in organic chemistry under the direction of the recipient. Ken was honored for his research on chemical bonding in organic systems. He has studied the preparation, reactions, and other properties of compounds containing small rings of carbon atoms in order to understand the chemical effects of changing bond angles. Ken is a member of the National Academy of Sciences. He is author or coauthor of some 200 publications in scientific journals and is author of the book *Physical Organic Chemistry.* Previous honors include three other awards and two fellowships.

George Keller was named California Industrialist of the Year by a blue-ribbon panel of business leaders. George was recognized for his role in Chevron's $13.3 billion acquisition of the Gulf

PHOTO: CALIFORNIA MUSEUM OF SCIENCE AND INDUSTRY

Corp. and for his work as chairman and director of the American Petroleum Institute (API). George is chairman and chief executive officer of the Chevron Corp. The Chevron-Gulf merger nearly doubled the size and value of Chevron during a difficult time for the U.S. petroleum industry. The merger created more than 1,000 new jobs for Californians. As chairman of API George articulated the plight of the oil business and the importance of preserving a potent and energetic domestic industry. George delivered this message to Washington decision-makers and to the public.

Harold Hollister and wife, Mary, are raising pheasants, quail, partridges, popcorn, sweet corn, garden vegtables and bird dogs. They operate Cherrybend Pheasant Farm, a gamebird hunting preserve in Wilmington, Ohio. Holly invites you to drop in.

Ken Bushway died in April. He was a chemical engineer at Nassau Chemical Co. in Ewing, N.J. Prior to joining this company in 1976, Ken was with B.F. Goodrich for 27 years and worked in Massachusetts and Connecticut. Ken was an army veteran of World War II. He was a member of the West Trenton Presbyterian Church. On behalf of our class, I extend our sympathy to his wife, Elizabeth, their three children and five grandchildren. . . . **Herbert Ward** died in Lebanon, Ore. Our sympathy to his wife, Donna.—**Marty Billett,** Secretary, 16 Greenwood Ave., Barrington, R.I. 28066

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Although it is winter here in Boston, **Alan Collins** wrote the following back in June. "I'm still teaching graduate students in systems management around the world; have been in the Orient for the past year and, after two weeks in the states in July, will be in Europe for the next 18 months." (We envy you, Al, but, if you are in Europe, you won't be at our 40th Reunion. We will miss you.) Continuing, Al says: "After 'bachelor-ing' it for the past ten years, I married the former Delia Cortes last year. We plan to take off September-October and meander around Europe, something I was lucky enough to have done once before—except with three kids in 1963. We're both eagerly looking forward to the experience. Ain't semi-retirement grand!" (Secretary's query: Al—weren't you the one with the smashing red Pontiac convertible at our 5th down on the Cape?)

James L. Marshall writes: "I am into a self-designed pre-retirement arrangement at Villanova University, teaching one semester per year in electrical engineering. This gives more time for musical activities such as composing, playing in string quartets, and jazz piano; and for reading, languages, and various other interests." (Scribe's note: time never hangs heavy on a Tech man's hands.)

Henry S. Rowen writes cryptically that he is Edward B. Rust Professor of Public Management at the Graduate School of Business and a senior fellow at the Hoover Institution—all at Stanford University. Even more cryptically, the Institute tells me that Henry's 40th reunion gift for unrestricted purposes is $10,000. **Tom Tooey,** our ball-of-fire Reunion Gifts chairmen, and all the rest of us are grateful to Henry for this significant contribution to our school.

Axel Kaufmann is a principal at the Boston architectural firm of Jung/Brannen where he is involved in "large" projects. "Large" struck me as a somewhat flexible term so I called. "Large? What's large?" I asked. To this Axel replied: "Well, 225 Milk Street, Boston, is large." Being a Bostonion, I can tell you that 225 Milk Street ain't small. It is a high-rise business building. Axel, unbelievably, still plays a fast game of tennis despite a hip replacement several years ago. He and his wife Marion celebrated their 25th with a trip to Mexico recently. Daughter Laura is finishing her second year at New England School of Law and daughter Jessica is graduating from Boston University. He hopes to attend our 40th.

By now, all of you will have received detailed information on our 40th class reunion including a request for dues. We use these to finance the many costs of a reunion but the end result, an unforgettably good time, make the contributions worthwhile. At our August 11 meeting, Sonya and **Frank Hulswit** came all the way down from Kennebunk, Maine, while Doris and **Mal Kurth** drove in from Brookfield, N.H. Locals who made it were Dot and **Jim Christopher,** Nell and **Fletcher Eaton,** Eunice and **Joe Schneider** and Mickey Ligor. Diana Strange and Eliza Dame from the Alumni Office provided invaluable support. See you there!

I must report, sadly, that **John H. Wykes** died from cancer and heart complications on June 20, 1988. He lived in Rancho Palos Verdes, California with his wife Louise. John was a member of the technical staff in the B-1 division of Rockwell International. I regret the lack of further details. The class extends its deep condolences to John's family.—**Fletcher Eaton,** Secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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Hansjoerg Stern, after 30 years of industry work with GE, has entered the world of academia at Purdue University. He teaches fluid engineering and consults part time. He was pleasantly surprised when he ran into **Margaret Coleman Haas** on the campus. He spent last summer as visiting professor at F.H. Koeln (W. Germany). He now lives in W. Lafayette, Ind. . . . **David M. Benenson** assumed the position of dean of the Catholic University School of Engineering and Architecture this year. He was the chairman of the Department of Electrical and Computer Engineering at the State University of New York at Buffalo. . . . **George W. Santos**, M.D., who is presently professor of medicine and oncology at the John Hopkins University School of Medicine, was this year the recipient of the Bristol-Myers Award for Distinguished Achievement in Cancer Research. He is a leader in the field of bone marow transplantation.

Edward L. Friedman was recently honored by the University of Hartford on its annual recognition day. Ed is presently an associate professor of electrical engineering at Hartford. . . . **Mel Gardner** was recently elected to the board of directors of Allegheny International, Inc., of Pittsburgh, Pa. Gardner is president and CEO of Melvin J. Gardner & Co., an investment banking firm.

We are sad to report the following deaths of our classmates: **John R. Bedell** of Madison, N.J., and **Ross R. Quincy** of Wilton, Conn.—**John T. McKenna**, 9 Hawthorne Pl., 10-H, Boston, MA 02114

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Our class president, **William L. Maini,** was honored by his firm, Symmes, Maini and McKee Associates (SMMA). The elegantly tasteful reception, held on August 2 at the Museum of Fine Arts, was in commemoration of his vision, achievement and dedication as past president of SMMA and in celebration of his new role as consultant to the firm. Thomas E. Vogel, president of SMMA hosted the ceremony and along with friends and colleagues, Parker Symmes and Jon Mckee, presented Bill with a contribution in his name to the MIT Center for Real Estate Development. Joining Bill were over 200 employees, business associates, and classmates. Bill's wife, Maria, his mother Signe, and his children, Pamela, Lisa, and Craig, and his brothers, Robert and Edward were all there. I was present and it was a pleasure to hear so many others confirm what we already knew of how very special a person Bill is.

The Outstanding Engineer of the year, the highest honor given by the Texas Society of Professional Engineers, has been bestowed upon **Herbert H. Woodson.** Active in the development of the engineering program since joining the University of Texas, Austin, in 1971, he was appointed acting dean in September 1987. With faculty recruitment his highest priority, he has spent much of the past year completing the designs for the $20 million facility to be constructed at the Balcones Research Center. As director of the Center for Energy Studies and interim director of the Center for Fusion Engineering, his interests involve electromechanical energy conversion and electric power systems including applications to the railgun project in development at their Center for Electromechanics. Dr. Woodson was appointed to the Texas National Research Laboratory Commission in 1987 and has been a consultant on several nuclear projects in Texas and a member of the board of the Atomic Industrial Forum. He was the initial holder of the Cockrell Centennial Chair having previously held the Texas Atomic Energy Research Foundation Professorship. Prior to his current appointment, he was the chairman of the Department of Electrical and Computer Engineering.

Richard D. Packard enjoys running across Mass. Avenue Bridge down to the Esplanade with friends from M.I.T. and Draper Laboratory staff as part of the group called the "River Rats." Richard is beginning to back off of his consulting practice, occasionally going to the Mitre Corp. He retired as a colonel from the Army Corps of Engineers after 40 years of service including Korea. Much of his active professional career was spent in semiconductor device processing including active devices and with infrared detectors. He is looking forward to seeing more of us at the next reunion. . . . Serving as a vice-president for the Chase Manhatten Bank in telecommunications planning and engineering, Colonel **Francis J. Davis** sent us much good news of his family. His son Paul graduated medical college in May and is now in neurosurgical training. His daughter Tracey married John Baker of Chicago in June. His daughter, Betsy starts Norwich University in Vermont this August. . . . Having completed the expansion of Mobil's Torrance, Calif., refinery, **William R. Lucas** is now trying to choose between taking a reassignment or retiring to do consulting or becoming more active in some joint ventures in Texas real estate. . . . Following retirement and serving as a consultant for Colgate Palmolive, **James Ryan** is monitoring the manufacturing of a new cosmetic line, Lournay Products.

We received word of the passing of **Frederick D. Newell** in May 1988. Fred spent much of his life making airplanes safer for instrument landings. He was a specialist in designing aircraft simulations for the Boeing Aircraft Co., the Cornell Aeronautical Laboratory and General Electric. While at M.I.T., he founded the M.I.T. Flying Club. Our condolences are extended to his wife Barbara, his son William, and his daughters, Sandra, Wendy, and Linda, and to others of his family.

In other sad news, **Gerald S. Ikelheimer** passed away on June 14, 1988. We send our condolences to his wife, Charlene.

In the next issue, I hope to report to you on the September gathering of our classmates in the metropolitan Boston area at the home of Carol and **Dick Reedy** to provide a midpoint presentation of plans for our 40th reunion.—**Martin N. Greenfield,** Secretary, 25 Darrell Dr., Randolph, MA 02368

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The *Review*'s deadline notice for this copy says they want information about our classmates' "inventions, creations, and endeavors." As if to oblige, **Allan Tanner** writes that he is working toward completion of a protocol to determine the indoor radon potential of undeveloped land. This is certainly an endeavor and a creation, and probably requires invention, too. Allan is a geophysicist with the U.S. Geological Survey.

Assuming that I may be considered as one of my own classmates, it is germane that I received a phone call the other day informing me that my patent had been granted. I was considerably confused by the statement, because at the moment I was working on the resubmission of an application that had been despised and rejected by the patent examiner, and I was not aware of any other application. The reference, however, was to one in which I was a co-inventor, about an amplifier for a photoconductive detector. The other inventor had picked up on a badly realized idea of mine and made something elegant for which I am happy to take a share of the credit. Choose able colleagues, friends.

Please endeavor to share news of your own inventions and creations, as well as your hobbies, families, and travels. We will all be the richer for sharing it.—**Richard F. Lacey,** Secretary, 2340 Cowper St., Palo Alto, CA 94301

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By the time you read this, Christmas will be almost upon us. The problems of the long lead for magazine publication dictate this delay in learning about our reunion in June. Those who attended had a great time and are looking forward to the next one. The first event of interest was the election of officers for the next five years. **Marty Wohl** was elected president, **Dick Lindstrom** vice-president, **Dick Linde** treasurer, and yours truly, **Gil Gardner,** secretary. You may send me class items at my home address or give me a call when you are in town. The last time I talked to Marty, he said he was moving to the Washington, D.C., area, so you may be able to contact both of us if you are in town.

Those who paid their dues should have received the results of the questionnaire in the mail by now, but if you haven't, drop me a line and I'll see that you get them. **Jay Berlove,** who did the honors in analyzing the responses and gave a humorous presentation at one of the reunion dinners, promised to summarize the results and issue the report ASAP.

We had more than 40 couples at one time or another during the activities on campus, and 22 to 24 couples at Nantucket. The weather was rather dreary while we were in Cambridge, but the sun came out as we left Boston on Sunday and remained absolutely gorgeous throughout our three days on Nantucket.

We all had a great time sight-seeing on the island, and the food was excellent. One of the major topics of conversation, besides the coming election, was a suggestion that we not wait another five years before getting together again, but meet somewhere farther west than New England. In addition to enjoying ourselves, we could start planning for the next regular reunion. The 40th is a big event historically and I suspect that more of us will have the freedom to take a week off to attend. . . . I was surprised to find that a number of our classmates have already retired. In most cases retirement did not mean becoming a beach bum, but represented an opportunity to do something new while reducing pressure. Some retirements mean converting a hobby into a business, or doing something just for the fun of it. Our classmates seem to be a relatively relaxed and happy bunch, at least the ones who attended the reunion.

Our classmate, **Dick Simmons,** CEO of Allegheny Ludlum Corp., was a featured speaker (along with Lester Thurow, M.I.T. professor and dean of the Sloan School, Morris Tanenbaum, vice-chairman, AT&T Corp. and others) during the Technology Day symposium, "Materials, Productivity, and National Well-being." Dick presented an interesting insider's view of the evolution of one of the rust-belt companies that has learned how to beat the odds and compete in the international market in materials technology.

I'd say that is enough for now. **Bill Haberman,** our outgoing secretary who deserves a round of applause for hanging in there for the last five years, has left me with a few items for the next issue. Don't use that as an excuse. Send me some news or, just like the last time I was secretary, I'll fill in with the comings and goings of the Gardner clan, which now numbers four married children with five grandchildren and one more on the way, plus three unmarried children. I have only one left to get out of college—one more year to financial freedom. So get those items in to: **Gilbert D. Gardner,** Secretary, 1200 Trinity Dr., Alexandria, VA 22314, (703) 461-0331

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Back in May, the *Wall Street Journal* did a feature article on **Harry Faulkner** and his troubled Swedish company. Harry joined Alfa-Laval AB, in Tumba, Sweden, 31 years ago. He became president in 1980. The company, which makes dairy and food equipment, suffered a major downturn in 1984 when the European community imposed an unexpected quota on milk production. Ever since, Harry and his colleagues have been trying to recoup and, according to the *Journal,* are finally back on track and again moving into new areas and regaining their former position and profits. Congratulations and good luck, Harry!

Paul Koppel writes that, after 20 years as a chemical engineer, he changed careers and has been a financial consultant with Thomson McKinnon for the past 13 years. He credits his wife with providing the encouragement needed to make the switch. In his successful "new" career, he has served many M.I.T. alumni from his office in Bridgewater, N.J.

We are very sorry to have to report the death of **Charles Krakauer** on July 15. Charles was vice-chairman and a director of Bowmar Instrument Corp., which manufactures electronic and electromechanical products. Before he become ill, he was president and chief operating officer of the company, which had pioneered the hand-held calculator. Our sincere sympathies go to his wife, Molly, and their six children.

Again we remind you to mark the dates of June 8-11, 1989, and make your plans to join us for your 35th reunion in Cambridge.

As we noted last issue, some of our classmates are lost; that is, we have no current address for them. We gave you half the list last issue; here are the rest: **Francis B. McKee, George Mealey, John S. Medal, John J. Melavas, Maitri Mojdara, William F. Moody, Jr., J. Scott Mudgett, William G. Nance, Hossein Nasr, Robert H. Nelson, Jr., David G. Newton, Harris A. Notarys, Edward J. Ofengand, Hiroshi Ohashi, Abraham Perera, Stephen G. Perrin, Vidyut Prakash, Walter F. Prien, Jr., Kenneth E. Ralston, Gabriel A. Reti, Robert B. Riley, Elain E. Rothleder, Paul Rudzinski, German R. Salazar, Arthur Sargent, Jr., Rev. Raymond T. Schaub, OP, Abraham Sender, Hideo Seo, Joseph J. Shay, Richard M. Sherwood, Murray H. Silverman, Howard J. Simmons, Melvin H. Smith, Wallace H. Smith, Carlos Soto y Cardenas, Archie L. Spratt, Obie L. Stallcup, Jr., William T. Strike, Jr., Raymond M. Swanson, Jr., Jose G. Tamayo, Ouri T. Tchervinsky, Robert H. Tucker, Roger G. Turgeon, Alexander S. Tweedie, Jr., Thomas F. Twomey, Manuel S. Vigil, Albert W. Vinal, James A. Wall, Richard G. Wilson, Samuel Yanay, David C. Yung, Alexander Zabludowsky, Frederick M. Zanella, and John G. Zarcaro.**

If you know the addresses of any of the above, please let us know or send a note to the M.I.T. Alumni Association.—**Edwin G. Eigel, Jr.,** Secretary, 33 Pepperbush Lane, Fairfield, CT 06430; **Joseph P. Blake, Jr.,** Assistant Secretary, 74 Lawrence Rd., Medford, MA 02155

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I am sad to report that **Avery Johnson** died on June 21 as a result of a crash in his ultralight plane. Avery was an inventor and held a Ph.D. from M.I.T. He was extremely active in the town of Milford, N.H., as a selectman and the town's truant officer. Avery donated thousands of hours to the town to help develop its computer system, which he continued even after he lost his second bid for selectman. Town officials stated that he was one of the most interesting, wonderful, and compassionate men they had ever met.

The American Society of Mechanical Engineers named two of our classmates as recipients of national awards in recognition of outstanding service to mechanical engineering. **Richard Schwind,** supervisor, measurement systems, Westinghouse Electric Corp., Sunnyvale, Calif., received the Melville Medal for an original paper on mechanical engineering presented for publication. **Herbert Richardson,** deputy chancellor and dean of engineering, College of Engineering, Texas A&M University, received a general award for a lifetime of service in engineering.

We also heard from **Lewis Pilcher** that he is an associate manager in the Commercial Systems Division of Hughes Aircraft Co. His address is 22634 Benner Ave., Torrance, Calif.

Bernard Wuensch, TDK Professor of Materials Science and Engineering, has been named director of the Center for Materials Science and Engineering effective July 1, 1988. He was named TDK Professor at M.I.T. in 1985, and his teaching and research have advanced significantly the technical understanding of how structures at the atomic level influence the useful properties of ceramic materials. In 1987 he received the Outstanding Educator in Ceramic Engineering Award sponsored by the Ceramic Educational Council.

Bob and I need more news about the outstanding achievements of our class and just news of your activities. Keep the mail coming.—Co-secretaries: **Robert P. Greene,** 37 Great Rock Rd., Sherborn, MA 01770; **DuWayne J. Peterson, Jr.,** 201 E. 79th St., New York, NY 10021

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Harry Levine is still "doing my thing" with Polysystems, a computer systems house specializing in small business/manufacturing systems plus CAD. They have been autocad dealers for over five years. His wife, Linda, is still teaching. Their children Todd (25), Mara (24), and Sari (23) have all joined the "workforce" in one way or another. Harvey and Linda reside in Edison, N.J. . . . **Laurence I. Moss** is president and CEO of a new venture, Demand Shift Technologies, Inc. DST designs, manufactures, markets, and supports equipment to shift demand for energy off-peak hours. Its first product is an electric thermal storage unit for use in heating for commercial and industrial buildings. . . . **Emanuel P. Papadakis** was appointed associate director for non-destructive evaluation at Iowa State University in January 1988. Emanuel holds the rank of fellow in the Acoustical Society of America and in the American Society for Nondestructive Testing. He was appointed technical editor of *Material Evaluation Journal of ASNT* (voluntary) as of April 1988.

Ed Zoolalian is on his 21st year at NEFF and is enjoying it. He has "retired" from five years on the city council of Monrovia, Calif., but still remains chairman of the Private Industry Council (JTPA) and member of the library board. Ed and Denise's son Jim (eldest) is a senior at UCLA (a communications major), and daughter Linda (youngest) will start at the New England Conservatory of Music, which means they will be visiting Boston more.

It may prove hard to remember those hot, muggy days of last summer (as of this writing) and what did happen to the Tigers, Sox, and Yankees. Secretary George managed to bag some 4,000 footers (mountains) in Maine, bicycle in Vermont and New Hampshire, and do some tidewater canoeing off Mt. Desert. Enjoy Thanksgiving and the upcoming holidays.—Co-

Bob Pollard, '56: He Made It Look Easy



A member of the class of 1956 wrote to Robert R. Pollard's widow, Thelma, after Bob died in January 1985. He also shared the letter with the readers of the Review.*—Ed.*



Dear Mrs. Pollard:

I find it difficult to write this letter to someone whom I have never met, saying things she already knows about a man I never saw after we graduated in 1956. Yet, I believe we all live in the memories of others and I thought you might like to read some of the memories I have of the days Bob and I spent at Tech.

Bob was the type of fellow we all wished we could be at Tech. He made it look easy and proved that it could be done. I had to fight to get a passing "C," but he fought to get the "A." I studied hard every night and used the weekends just to catch up. Bob had time to "live" while earning his 4.93/5.00. Good grades and time for fun too—kind of the impossible dream.

He told me it was just a matter of concentration: when he studied that's all he let into his mind. And when he played he did not worry about work. Having a special place where there is only work, and no daydreaming, is one of his suggestions that I have passed on to many others who were having trouble studying.

I remember his one "B." Our advisor looked at his report card and asked what he was going to do about this "bad" grade. Bob told him the obvious—"I dropped the course."

I first met Bob when I saw him leaving an exam worried and saying he should have done better. I tried to cheer him up, saying there was always the next time—he might do as well as me. Needless to say, he got the highest grade in the class on that exam and was complaining because he did not get 100. That was when I found out he got all "A"s and the last time I ever offered any advice or sympathy to him after an exam!

On one occasion four of us were assigned to work on a group project. Bob covered the "theory," I was the "worker," and the other two were taking care of data. During the data-taking, we ended up with a smooth curve except for one "wild" point that was way out of line. Bob looked at the plot and said that the "wild" point must have been an error and we should have been smart enough to recognize it as being wrong. Could a "C" student disagree? No way—we were just glad to have him on our team! So we dropped the point and presented the graph as a smooth curve. Bob figured out the theory and made the oral presentation for us in front of the whole class. After he was finished, the teacher got up and said it was a pity we had not taken more data, because the reaction had a spike in it; it was not a smooth curve. Yep, the spike was just where our "wild" point was! Poor Bob—he faced the stares of his three co-workers and for once lost his cool. Of course, we went back to take more data and "found" the spike as the teacher had suggested.

I particularly enjoyed the episode in senior year, when Bob took the name of Reggie Jones and signed up for an extra class. That should be recorded as a "classic" at Tech. I think the class was in "strength of materials." The teacher that Bob was assigned was great on theory but did none of the problems. The other teacher did little theory but worked all the problems on the board. We were supposed to hand in IBM cards at each class, but somehow the second teacher forgot that Bob never turned in an official card and recorded him as "Reggie." The rest of us loved it—he had beat the system.

"Reggie" was a fair student—he took the tests and turned in the quizzes, but he would not spend much time on them. He would do just enough to prove he knew the subject. After all, "Reggie" was not going to get a grade. The teacher was always annoyed—telling "Reggie" he knew he could try harder and get a better grade. I think he had a "B" even without trying!

At the final exam Bob had intended to write something like "this is too hard" and turn it in under "Reggie's" name. But as it turned out the exam *was* hard, and he spent all the time solving it and had no time to continue the joke. The teacher became concerned when no final exam was turned in by Reggie and went to see if he was sick. When he found there was no such person in the school, he spent the next day going through all the freshman I.D. pictures trying to find "Reggie." I guess he was really angry by the time he got to the "P"s. He telephoned Bob late at night and asked to see him the next day in his office. Bob's reply was, "Should I bring Reggie with me?" If Bob had taken the final exam in Reggie's name, it would have been more trouble and might have had an effect on graduation. But when the professor learned that Bob had all "A"s for the four years he relented. Bob explained why he did it, and the teacher said Bob was off the hook. But all the class grades had to be adjusted without "Reggie's" scores.

Bob followed Norbert Wiener—the most intelligent man in all of M.I.T.—to the Coop one day, "just to see what a genius does." Wiener looked through the paperback books, picked one up, and started reading it. After a short time he looked at his watch, folded down the page corner, and put the book back on the shelf. Bob went over to the clerk in charge and said, "Did you see what he just did to that book?" "Yes," she replied, "and he gets real mad if I sell it before he is through reading it!"

These and many other memories of Bob keep him alive in my mind. I am sorry he is not here with us still, but he will always be a part of my life since he truly influenced my years at Tech in a very lasting way. □

ILLUSTRATION: HENRY B. "CHICK" KANE, '24; MIT MUSEUM ARCHIVES

secretaries: **George H. Brattin,** 39 Bartlet St., Andover, MA 01810, (508) 470-2730; **Irwin C. Gross,** Sweet's McGraw-Hill, 1221 Ave. of the Americas, New York, NY 10020, (212) 512-3181

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We extend condolences to the family of **Michael Hopper,** who died in June at the University of Massachusetts Hospital in Worcester. He had retired in 1987 as manager of scientific systems at Wyman-Gordon Co. in Grafton and Worcester, and leaves his wife, Cha-Nan, three sons, a daughter, and two grandchildren.

Kenneth Hoyland is now clinical professor of ophthalmology at the University of Colorado Medical School. He says he still enjoys sailing, which he learned in the Tech dinghies. . . . **Andrew Viterbi** spoke this spring at the colloquium series of the Laboratory for Information and Decision Systems on "Coded ALOHA: A Simple Approach to Increasing Multiple Access Throughput." He is the founder of both Qualcomm, Inc., and the Linkabit Corp. and is a professor of electrical and computer engineering at the University of California, San Diego. . . . **Paul Carr** and **Alan Budreau** were both members of a recent panel discussion on microwave applications of high temperature superconductors held at the M.I.T. Lincoln Labs. Paul is chief of the Components Technology Branch of the Electromagnetics Directorate, Rome Air Development Center. Alan is the independent research and development coordinator of Sanders Electronic Components Business Division.—**John T. Christian,** Secretary, 23 Fredana Rd., Waban, MA 02168

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The Big Story: 30th Reunion a Big Success. Our 30th reunion was highly successful with nearly 120 people participating in the Edgartown, Martha's Vineyard, and Boston activities. Even a little drizzle on Saturday couldn't dampen the enthusiasm and camaraderie. Sunshine arrived in force on Sunday, just as ordered by the reunion committee. Many thanks from the attendees and the entire class to **Roy Scarpato,** chairman, and to the members of the committee for an extremely well-planned event. Typical of the details reflecting good planning were the fruit and snacks provided on the bus from Boston to Woods Hole. Our thanks to **Milt Jones,** who was in charge of transportation arrangements, for this nice touch. The class profile was ably compiled by **Dick Rosenthal, Ralph Schinzel,** and **Bud Medeiros.** Arrangements for the band, which played a good mix of tunes, were handled by **Gary Fallick, Irv Stiglitz, Jay Taylor,** and **Frank Tahmoush.** Our wine stewards were **Pete Ricupero** and **Frank Tahmoush. Dan Holland** served once again as our sports counselor. **Martin O'Donnell** served as unofficial legal advisor, and **Steve Hadjiyannis,** our class treasurer, kept us solvent once again. Arrangements for the class souvenirs were made by **Gary Fallick.**

Special awards were presented at the reunion banquet in a variety of categories. Winners of the "Longest Distance Traveled to the Reunion" were: Somwong and **Eddie Changkasiri,** Bangkok, Thailand; Mary and **Sars McNulty,** London, England; Karen and **Bob Schmidt,** Seattle, Wash.; and Loretta and **Ray Danon,** Mexico City. Recipients of the "Married the Most Years" award were Phyllis and **Jack Raymond** with 37 years. Capturing the "Youngest Child" award were Judy and **Joe Mulloney,** who have a 3-month-old son. They were followed by Karen and **Frank Tahmoush,** whose daughter Heather, age 3, was at the reunion. "Longest Sleep" went to **Herb Johnson,** with a winning time of 12 noon on Saturday. Winners of the running events were: 5-mile, **Pete Peterson;** 4- and 2-mile, **Ed Newton** and **Pat Holland.** Anniversary while at reunion: Arlene and **Irv Stiglitz** celebrated their 28th.

Next month, we'll have "stats" from the class profile. In the meantime, here is some other news. . . . **Edwin Bell,** who is with the real estate brokerage firm of Coldwell Banker in Los Angeles, writes, "My son Walt is an independent systems design and programming consultant, while my daughter Leann is studying at Monash University in Melbourne, Australia, on a Rotary International Scholarship. My youngest son Mark studied economics at Hull University in England during his junior year abroad." . . . **William Cooper** writes that he is "still at Lawrence Berkeley Laboratory, and still trying to make fusion work! Our sons, Bill and John, now 17, rowed on the U.S. Junior National Team at the World Championships in Cologne. John rowed in the eight that won the gold, and Bill stroked the four that took an eighth place." . . . **Ron Tweedie** is currently director of Data Services with the New York State Department of Transportation.

Jerome Levine, a mathematics professor at Brandeis University, received the U.S. Senior Scientist Award from the Alexander von Humboldt Foundation of West Germany. This award enables him to spend up to a year in Germany, during which time he will exchange ideas with professional colleagues and attend conferences there. He has served as chairman of Brandeis' Mathematics Department and has also been a visiting scholar at Oxford University and a visiting professor at the University of Geneva in Switzerland.

As a former Texas Instruments alumnus, I was particularly interested in hearing from **Dale Dukes,** who has just joined TI as marketing manager for the firm's CASE (Computer Aided Software Engineering) product line. Dale notes that "it's exciting to be associated with a hot product in a hot field again. My oldest son Glen graduated from Rice this year with a bachelor's in electrical engineering. . . . During the reunion, your secretary turned into a roving reporter, and we'll have lots of news in the next few months about folks who were at the reunion. Merry Christmas to you all!—**Michael E. Brose,** Secretary, 841 Magdeline Dr., Madison, WI 53704

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I am sitting here in Ithaca on one of those hot and humid August days that many of you still recall, even though (as you read this) it's now late fall. I was just about to let this deadline slip away like so many others because you, my classmates, have not sent **Art Collias** or me one bit of news for many months. But, then, I noticed that this was to be published in the November/December, so-called holiday issue, and I said no, I will not let this opportunity pass. First, the opportunity to wish you and your wonderful families a terrific holiday season with the finest of new years to follow. And second, the chance to remind you once again that some of the news that you put in those holiday notes to friends would fill these columns to brimming with interesting items for the rest of us. Peace.

Editor's note: One '59 news item was sent by mistake to Henry McCarl, class of '62 Secretary, and he wrote it up as follows: **D.H. Avery III** continues to teach as professor of metallurgy at Brown University. He has spent about half of his professional time in the past 14 years in central and southern Africa with stints in [Iron Age] archaeology at the University of Capetown. He is still teaching yacht design and sailing with his three children—Jon Brown, Caleb Harvard, and Jessica Harvard. I'm not sure whether the kids are expected to attend those respective schools or whether they are place named for parental locations at times of birth. Perhaps D.H. could clarify the origins of the unique names of his children, or at least give us a description of what he means by "traditional Iron Bloomerigs!" Further clarification requested for the purposed of metallurgical enlightenment.—**Ron Stone,** 116 Highgate Place, Ithaca, NY 14850, (607) 257-2249

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Letters from academe brought good news from two classmates. . . . **Dick Bradt** is professor of materials science and engineering and Kyocera Professor of Ceramic Engineering at the University of Washington. Dick recently received the T.J. Planje-St. Louis Award for technical contributions to the field of refractories. Dick, his wife, Liz, and daughters Meredith and Claire live in Seattle. . . . **Ralph Buncher,** professor of biostatistcs and epidemiology at the University of Cincinnati Medical Center, was one of two University of Cincinnati faculty members (there are 2,000) given the A.B. (Dolly) Cohen Award for excellence in teaching. He is only the third member of the medical center ever to receive the award. Considering the glowing accounts of Ralph's teaching reported by his students, the award was richly deserved. Congratulations! Ralph also wrote that he works with another classmate, **Amadeo Pesce,** a professor of clinical chemistry, who is currently president of the faculty forum of the college.

A news release from the Turner Corp. announced the election of **Harold Parmelee** as the corporation's president. Hal has been with Turner since 1960. He has served Turner in a wide range of engineering, sales, and management positions, most recently as executive vice-president for Turner Construction, the corporation's largest subsidiary. Hal and his family reside in New Canaan, Conn. . . . Congratulations are also in order for **Howard Schlossberg,** a 1988 IEEE medal awardee "for technical leadership and for identifying and encouraging key areas of research in quantum electronics."

Many thanks to those who have taken the time to write and keep your classmates up-to-date. I hope to hear from more of you soon, so that 1960 appears regularly in the *Review.* Finally, my very best wishes for a happy holiday season and a peaceful, healthy, and prosperous 1989.—**Frank A. Tapparo,** Secretary, 15 S. Montague St., Arlington, VA 22204

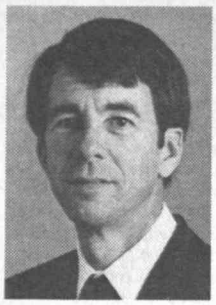
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Mary and I have just set up the new summer home in Gloucester, and being a confirmed computer nut, I had another C-128 system installed here so that we are fully compatible at both Casa South and Casa North—Birmingham, Ala., and Gloucester, Mass. The weather is really beautiful, with a cool breeze floating in over Good Harbor Beach and up the hill to our place at 28 Old Nugent Farm. If you get up this way in the summer (mid-June through Labor Day), give us a call and fill us in with class news about your personal life (at least what you wish to share with other '62 members) and professional and family achievements. Our summer phone is (508) 281-5269 (note the new area code for this part of Massachusetts).

The Alumni Office does manage to keep track of my whereabouts, so I have received the latest from the wire services and public relations departments. I also want to thank the increasing number of classmates who are writing to me personally since it is always good to get the news directly from the "horse's mouth!" (Especially considering the alternative.)

Robert T. Brady has been named president and CEO of Moog, Inc., of East Aurora, N.Y. Bob had been vice-president and division president of the Aerospace Control Group. I believe that makes at least three of our classmates who have been promoted to president and CEO of major American corporations this year.

William B. Lenoir, a former NASA astronaut, has been promoted to vice-president of the Booz, Allen & Hamilton, Inc., space systems group, with offices in Bethesda, and Seabrook, Md., Reston, Va., Houston, Colorado Springs, and Los Angeles. Bill was with NASA for 17 years and flew on the first operational mission of the space



William Lenoir

shuttle Columbia. At Booz, Allen he directs space systems and operations programs for NASA's manned space station, the space transportation system (shuttle), the Goddard Space Flight Center, the U.S. Navy Space and Naval Warfare Systems Command, and the U.S. Air Force Space Command. Remember when we were entering M.I.T. on the heels of the U.S.S.R. success with Sputnik, and the struggles to get our first satellites into space? We've come a long way since those days, and now our classmates are directing the space program efforts of our own country. It makes one really proud to be associated with y'all (South and North)!

George E. Ioup is now professor of Physics and Geophysics, and director of the Geophysical Research Laboratory at the University of New Orleans. George is in his third year as a Navy-ASEE Senior Summer Faculty Fellow with Naval Ocean Research and Development Activity. . . . **Talbot S. Huff, Jr.,** has received a 1988 IEEE Medal "for contributions to military intelligence systems." I guess we could tell you more about all that, but it seems to be highly classified, national security stuff.

Robert R. Barthelemy was the featured luncheon speaker at the Second International Metals and Metals Processing Conference August 2-4 at the Dayton Convention Center and Stouffer Plaza Hotel in Ohio. The theme of the meeting was "Space Age Metals Technology," and the meeting was sponsored by the Society for the Advancement of Material and Process Engineering (SAMPE). You will recall that we mentioned Bob in an earlier column this year when he was promoted as technical director of the Air Force Wright Aeronautical Laboratories to head the National Aero-Space Plane Joint Program Office. Bob is also an adjunct professor of aeronautics and astronautics at the University of Dayton.

Martin Klein writes that his company, Klein Associates, Inc., has received the New Englander Award from the Smaller Business Association of New England (SBANE). You will recall Marty's presentations at the 25th reunion on his work with side-look sonar to help find the *Titanic*, the *Atocha*, the *Lusitania*, the wreckage of the space shuttle *Challenger*, and to search for the Loch Ness Monster. Klein Associates equipment was recently used to find the wreckage of a South African Airways jet off the coast of Mauritius in 14,600 feet of water, even deeper than the *Titanic*. Klein equipment is also used by the U.S. Navy and many foreign naval forces for various critical operations, and for locating mines in the Persian Gulf. Thanks, Marty, for the good news. Keep up the fine work!

Rurik B. Halaby writes that his company, Agri-Capital Corp. is doing quite well as an investment bank for the agribusiness sector. Rurik's company is located in Suite 1925, 420 Lexington Ave., New York, NY 10170. His telephone number is (212) 972-5750, Telex: 4971927, and FAX: (212) 972-5741. Rurik's firm negotiates mergers and acquisitions, arranges financing, and provides financial consulting for a broad range of agribusiness companies. Recent clients have been involved in dairy production and marketing, feed suplement manufacturing and marketing, grain storage, and related businesses. So if you need some financial assistance for those billion-dollar mergers in farm products, give Rurik a call in New York.

John S. Yuan writes that after 25 years in the far-flung reaches of the world (including most recently White Plains, N.Y.), he is returning to the Boston area, having joined Goldberg-Zoino & Associates as vice-president for Environmental Business Development. GZA, an environmental and geotechnical engineering services company, is based in Newton Upper Falls, Mass. John and his family are looking forward to living in the area once again and getting reacquainted with some of their classmates.

As always, keep those cards and letters coming to: **Hank McCarl,** Secretary, P.O. Box 352, Birmingham, AL 35201-0352

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A full mailbox makes me happy, and by golly I'm about as happy as a politician in a roomful of kissable babies. Let me start with a delayed item from **Ron Walter,** that "they" accidentally routed to '64: he is still at Citicorp after nine years, responsible for corporate strategic analysis. He and his wife Marilyn, who is a professor at Brooklyn Law School, have two daughters—Alison (1) and Amy (14). . . . **Larry Demmick,** who lives with his wife, Debbie, near me in Edgewater, Md., is also one of these stable-job fellows. For the past 22 years, he has been with MPR Associates, a small firm that consults for the utilities industry. . . . **John Addis,** another long-timer, has been with the Tektronix, I believe, since we graduated. John designed all the analog ICs used in Tektronix' four original 11,000-series 'scope plug-ins. He has been in Lab Instruments but is moving to Portable Instruments and promises to issue more amplifiers soon.

Elliott Bird says the 25th reunion "was great," and he is looking forwardto the 1993 edition. Elliott and family were to spend, as of his early-summer writing, the hot season in Prague, Vienna, and Budapest, while his son Eric went to Ghana as an AFS exchange student. . . . **Bob Turtz** reports being a partner in the Newark, N.J., law firm Carpenter, Bennett & Morrissey, and also (part-time) municipal judge of nearby West New York, N.J. He is married to Susan Goldman, and they have sons Evan, 19, and Doug, 14.

One more of our classmates has turned to software. (Well, it's better than turning to drugs.) He is **Harry Koons,** who founded Double Eagle Software, of Torrance, Calif., the main product of which is *The Tax Advantage*, a tax-prep program for individuals and sole proprietors. . . . **Bob Goode** reports being chosen "Outstanding Science Teacher of 1986" by the New Jersey Scientific Research Society. The plaque and honorarium were presented to him by astronaut Sally Ride. Congratulations, Bob. . . . **Terrence Chatwin,** of Salt Lake City, now has six children and also started a new but growing business about two years ago, in hazardous waste. So folks, if you need a delivery, give him a call. Seriously, he also is a top-level squash player, who won several matches in the 1988 National Championship in the over-45 group.

Marshall Flam, with whom I shared both college class and second-grade class (but nothing between), is sorry he was unable to attend the 25th reunion. He and wife Laura were expecting their fifth daughter in September and planned to spend the summer in France and England. He is still practicing hematology and oncology and is co-writing a book on combined chemotherapy and radiation in cancer treatment. He is in contact with many T.E.P. brothers who live in California (he lives in Fresno) and would like to hear from others.

I believe I mentioned earlier having joined a small firm that provides accounting and estimating systems for the construction industry. I am working my fanny off, as I am responsible for sales, support, marketing/advertising, product and vendor choice, collection, everything but keeping the books, but I am having a ball. Linda and I may also be about to adopt a baby; I'll let you know how it turns out next time. Keep those phone calls, cards, and letters coming.—**Phil Marcus,** Secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043, (301) 750-0184

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It's a hot and steamy early August in Washington. Writing a column that will appear in mid-to-late November does help me to feel a bit cooler. There are a few Alumni Fund notes and news clippings left, but that's it. Please send some news.

Bert Knight writes from Louisville, Ky., that he is president of United Catalysts, Inc., and has served as such since 1977. He is also serving as the chairman of the Metal Catalysts and Producers Panel of the Chemical Manufacturer's Association. . . . **Alan Gamse**, a partner in the Baltimore law firm of Semmes, Bowen & Semmes, has been appointed chairman of the American Bar Association's Committee on Continuing Legal Education of the Tort and Insurance Practice Section.

Alfred Spencer has become a computer consultant with Langlais Software of Merrimack, N.H., (a firm founded by George Langlais, '73). Alfred lists his home address as Framingham, Mass. . . . **Franklin Darmory** has joined Alcide Corp. in Norwalk, Conn., as executive vice-president and chief operating officer. Previously, he had spent 15 years with Rhone-Poulenc, Inc., a French pharmaceuticals and chemicals manufacturer. In addition to his M.I.T. degree, Franklin has also earned a Ph.D. from Columbia University and and M.B.A. from Iona College. . . . **Martha Redi** writes that she is doing research at the Princeton University Plasma Physics Lab. Her husband, Olav, is at the NYU Department of Physics. Her son Jason is now attending Lehigh University to study computer engineering.

Bob Weinberg received a $200,000 grant from the American Cancer Society to study oncogenes. He is a professor of biology at M.I.T. and also a member of the Whitehead Institute for Biomedical Research. Bob's work has received national media attention. . . . **Roger Lewis** is still an architect, professor at the University of Maryland, and author. The AIA Press published *Shaping the City*, a collection of Roger's essays and cartoons from Roger's weekly column in the *Washington Post*. His book *Architect? A Candid Guide to the Profession*, published by M.I.T. Press in 1985, continues to sell. Much of Roger's time is now spent as a visiting lecturer, guest speaker, and critic.

I attended a short course as part of the M.I.T. Summer Session and, with Louise, had a chance to "test out" the Cambridge Center (Kendall Square) Marriott, which will be headquarters for our 25th reunion in June. **Bill O'Halloran,** our reunion chairman, made a fine choice. In future columns, I'll present more information about our reunion plans.—**Joe Kasper,** Secretary, 3502 Idaho Ave., NW, Washington, DC 20016

65

This month's package is thick, more with press releases than fund envelopes, but at least it gets us a column again. **Peter Sexton** writes that in May he accepted the position of vice-president at Chemet Corp. in Attleboro, Mass. Chemet is a specialty producer of precious metals with major product lines in arcing electrical contact materials and precious metal particulates for microelectronic applications. Peter says that they are affiliated with Metaux Precieux So Metalor of Neuchatel, Switzerland. Peter wrote his note just after attending the Materials Science and Engineering centennial and while waiting for **Bill Mooseker** to join him hiking in the Cascades. . . . **Dan Diamond** proudly writes that daughter Elizabeth graduated in June from Allegheny College with a

double major in art history and french. She entered the University of Delaware graduate school this fall.

Bill Grosky sends a brief note that he's now acting chairman of the computer Science Department at Wayne State University in Detroit. . . . **Mary Coffey** writes that she's working for Bechtel/Parsons Brinkerhoff on the central artery/third harbor tunnel construction in Boston. She's involved in the environmental analysis and permitting for the project. As I'm assembling this column, it's Sunday, and there's an article in the *Boston Globe* magazine on what the project will or won't do to Boston traffic!

Eoteos Macrides, a principal scientist at the Worcester Foundation for Experimental Biology, is the recipient of a Javits Neuroscience Investigator Award from the National Institute of Neurological and Communicative Disorders and Stroke. The award provides $1.9 million over seven years to support research on "olfactory and neuroendocrine functions." . . . A news clipping from the *Middlesex News* brings word that **Jim Pepe** has been named vice-president of software development at Prime Computer. Jim has been with Prime since 1982.

Michael Keehner, a senior vice-president of Kidder, Peabody Group, Inc., has been appointed to the board of directors of Financial Guaranty Insurance Co. Michael's primary responsibility is as managing director, asset finance, of Kidder Peabody. . . . The Alumni Office forwarded a press release on the 1988 IEEE medals presentation in Boston last May. **Tom Barnwell** was named a fellow of the IEEE for contributions to algorithms for digital coding of speech signals, and **John Woods** was cited for contributions to multidimensional signal processing, image modeling, image restoration, and image compression.

Since this is the November/December issue, it should be cool when you receive it. I'm writing the column at the end of July in the middle of one of the Boston area's longer runs of hot, humid weather. If I'd wanted weather like this, I'd have gone back to Houston after graduation.—**Steve Lipner,** Secretary, 6 Midland Rd., Wellesley, MA 02181

66

I received a long letter from **M. Eugene Sherman,** who was our first class secretary after graduation. We all remember that far back, don't we? He and his wife have been practicing medicine in Colorado for the past 11 years. He is also racing a Sports Renault with the Sports Car Club of America for the third season. His son Jon (16) is an accomplished hockey goalie, and his daughter Jill (11) is active in theater productions.

John Day has been promoted to general production manager, biochemical, at the corporate office of Pfizer in New York. . . . **Norman Rubin** writes that he is alive and well and still a "professional anti-nuke." He is also becoming a serious racer of Albacore-class sailing dinghies. . . . **Morton Cowan** is living in Marin County with his wife and two children. He is on the faculty at the University of California, San Francisco, where he is the director of the bone marrow transplant program. He is currently on sabbatical at Genentech, Inc.

This is the hottest summer in years. Think back on it as you read this with winter coming on.—**Jeff Kenton,** Secretary, 7 Hill Top Rd., Weston, MA 02193

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Murray Katcher was recently appointed maternal and child health director for Wisconsin. He is a pediatrician for the State of Wisconsin and the University of Wisconsin.

Please write! This column has become too short.—**Jim Swanson,** Secretary, 878 Hoffman Terr., Los Altos, CA 94022

69

The volume of class notes has slowed to a trickle, much as the unrelenting August heat has made once-bubbling New Hampshire brooks sluggish. Let's hope that the greenhouse threat turns into a mirage, but I, for one, fear the worst.

Peter J. Hirz writes that he and his wife are expecting a brother or sister for Jonathan, who was 17 months old in August. . . . **Peter T. Kleeman** is an associate professor at the Institute of Textile Technology in Charlottesville, Va., and is working to exploit computer-aided manufacturing opportunities in U.S. textile production. . . . **John M.L. Gruenstein** has started a consulting firm, BPA Economics, that provides business and litigation support in real-estate economics and other areas. One specialty of the firm is the effect of asbestos on property values. John is also principal economist at Berkeley Planning Associates and teaches at Berkeley, among numerous other projects. He adds, "No wonder I need a hot tub!"

Robert A. Barr is now working as a patent attorney in the Palo Alto office of Townsend and Townsend, a firm that deals with patents, trademarks, and copyrights. . . . For his contributions to the invention, standardization, and commercialization of local area networks (especially Ethernet), **Robert M. Metcalfe** has received the Alexander Graham Bell Medal from the Institute of Electrical and Electronic Engineers, Inc. In 1979, Dr. Metcalfe founded 3Com Corp. of Santa Clara, Calif., and is the principal inventor of the Ethernet local area network. . . . Actor **James Woods,** having left M.I.T. in his senior year to follow his dream, has starred in such films as *The Onion Field, Against All Odds, Once Upon a Time in America,* and *Salvador,* for which he received an Academy Award nomination. In May he attended the New England Institute of Technology's graduation ceremonies in his native state at Brown University. Both he and former Chief Justice Warren E. Burger were awarded honorary degrees. James Woods was introduced as "the most intelligent actor in Hollywood." Naturally, he was from M.I.T.! Wait a minute, though, he dropped out! On that discordant note, I think I'd best end these notes.—**Eugene F. Mallove,** Secretary, 183 Woodhill-Hooksett Rd., Bow, NH 03301

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I received a letter from **Thomas D. Halket.** He writes that he recently joined the New York law firm of Scheffler, Karlinsky & Stein as partner in charge of the corporate department. His practice includes a broad range of corporate matters, but his specialties are the representation of high technology companies, licensing, and venture capital transactions. He is also incoming chairman of the Section of Science and Technology of the American Bar Association and chairman of the ABA's Division on Ventures and Enterprise. He also serves on the board of advisors of the Westchester Venture Capital Forum and the New York Science Policy Association of the New York Academy of Sciences. He and his spouse, Amy, enjoyed the arrival of their third son last year and continue to live in Larchmont, N.Y.

John C. Eichelberger continues at the Geochemistry Division at Sandia Labs in New Mexico, where he has been with his spouse for the previous 14 years. Occasionally, they escape to the San Juan Mountains of Colorado. Specifically he's been drilling volcanoes in California for the past five years as part of the National Continental Scientific Drilling Program and has plans to drill the more vigorous volcanoes of Alaska. Their family includes a daughter and a son.

John Wurts is a founder of Management Decision Systems, Inc., which had been purchased in the late 1970s by Information Resources, Inc. After said purchase, he served as president and CEO of MDS. He also is the chairman of two local high technology start-up companies—Concurrent Logic, Inc., of Arlington and Obsidian Computer, Inc., of Cambridge. Most recently, he was named CEO and chairman of Symbolics, Inc. located at Cambridge, which is a maker of artificial intelligence systems. He was selected from a nationwide field of 20 candidates and was able to bring the company through its recent financial troubles.

Guillermo J. Vicens has been elected senior vice-president of Camp Dresser & McKee, Inc. He will be the manager of the environmental planning and management unit of CDM's New England area. This includes projects in the areas of water resources, environmental planning and sciences, site design, and management and financial services. He also is involved in computer modeling of environmental problems, including the clean-up of the Boston and New Bedford Harbors and the regulation of underground storage tanks. He received his doctorate from M.I.T. specializing in water resources and planning and management. He is a registered professional hydrologist as a member of various associations including the American Society of Civil Engineers and the American Water Resources Association.

Stephen K. Leslie sent a long letter summarizing the events of his life for the last ten years. He is the founder and CEO of International Projects Development, an international development and management consulting company. The IPD specializes in civil engineering, project management, international finance, and consulting for various countries throughout the world. He is currently commuting to Mexico, where several projects are proceeding, although he can be reached at the San Francisco office at 2744 Sacramento St., Suite 305, San Francisco, CA 94115 or (419) 563-7402. For the past ten years, he has been involved as an advisor to two presidents of Peru on national infrastructure and industrial development; worked for the Department of State in Latin America; manager for international studies for Bechtel Petroleum; troubleshooter for the Bechtel Group for projects involving Diablo Canyon Nuclear Power Plant and high speed pipelines for synfuels; and worked with **Tony Picardi** on the development of water and electricity in the kingdom of Saudi Arabia. He has also been involved as a visiting professor or lecturer at Stanford University, Berkeley, Catholic University of Peru, and other institutions. He is currently building up IPD as a core group of internationalists with associated groups in engineering, project management and finance, and a network of professors and semi-retired professionals at various countries through the world. Interested classmates who waited patiently for him to develop IPD should contact him. He remains unmarried and travels extensively.—**Robert Vegeler,** Secretary, Beers, Mallers, Bachs, Salin & Lamore, 2200 Ft. Wayne Bank Bldg., Ft. Wayne, IN 46802

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Paul Palmer has built a 50-foot sailboat. He apparently sent this note before, and it didn't make it in the notes. My apologies. . . . **Arthur E. Perkins, Jr.** has joined Ethyl Corp. as purchasing manager of operating materials in the company's Chemicals group. . . . **Gerald E. Kardas** writes, "After seven years on corporate staff at Combustion Engineering in Stamford, Conn., I have been appointed vice-president of marketing and planning at Amdata, Inc., a C-E subsidiary in Windsor, Conn. Carol and I now live in a condo community around a golf course in Avon, Conn. She recently added a degree in psychology from Marymount College to her background in interior design, and she is director of human resources at an architectural firm in Farmington, Conn. My daughter, Ellen, 11, is struggling through the preteen years.

Robert W. Handler M.D., is practicing opthalmology in Spokane, Wash. His main profes-

sional interests are surgical services for people over 60 and opthalmic equipment development. He has been living in Spokane with his wife, Deborah, and two daughters, ages 8 and 10, since 1981.

James L. De Lucas, M.D., is finishing up two years at the Aerospace Medicine Research Lab at Wright Patterson AFB in Ohio and will be going to Kynsan Air Base, South Korea, this summer to be the hospital commander for one year. . . . **John R. Hinton,** M.D., is an emergency room physician in Miami, Fla. He is married to Marlena, and they have three children—Eva (10), John Jr. (4), and Laila (7). His avocation is orchid growing. He travels frequently to Washington, D.C., and is renovating a house in Georgetown.

I have been appointed to the Estate and Gift Committee of the Section of Taxation of the American Bar Association.—**R. Hal Moorman,** Secretary, Box 1808, Brenham, TX 77833

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After being a visiting assistant professor of mechanical engineering at Florida International University for a year, **Janet Lantner** is returning this fall to the University of Houston as assistant professor of mechanical technology. . . . **Craig Lewis** has finished three years as an internist in Yap, Micronesia. He is returning to the U.S. with his wife, Lori, and children, Ben and Zoe, to begin an internal medicine practice in Farmington, Maine. . . . **Joe Edwards** has been nominated for reappointment as Maine Insurance Superintendent. This from a clipping in the *Bangor Daily News* which editorializes, "We are lucky to have him." . . . **Craig Melin** has been named president of Cooley Dickinson Hospital in Northampton, Mass. He is currently vice-president for external affairs at University Hospital in Boston.

Steven Vick writes, "I am running my consulting geotechnical engineering practice from the quiet mountain town of Indian Hills in Colorado. It has taken me to Ireland and the Netherlands in the past year, and I have just returned from a successful climb of Mt. Chimborazo (20,702 ft.) in Ecuador." . . . **George Brown** reports, "Now executive vice-president with American Financial Consulting in Troy, Mich. My scam: connecting innovators and investors. This is a big comeback after being reduced to a door-to-door meat salesman by a big vengeful corp. Trying to LBO an FTC-ordered divestiture to create a lab for experimental management science, I stumbled on a plot to monopolize roofing. The matter is now in appeals court. Married Moira MacAvoy (Wellesley '76); restored a 25-room Victorian in Toldeo; three kids, four cats, one dog." . . . **Marty Shinko** writes, "I'm still looking for work. The notion that there aren't enough good engineers or programmers in the country is fiction—my job searching shows that. Corporations have no use for experience (they use people once and throw them away), and the government creates its own artificial shortages with its catch-22 policy on clearances. Let's get this fixed."—**Dick Fletcher,** Secretary, 135 West St., Braintree, MA 02184

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Thin news this month. I'm referring to the stack of mail, not any great weight-loss reports. But I did get a brief letter from **David Mark,** who is still with the National Dairy Council in Illinois as director of Health Professional Education Programs. He finds the Midwest "too flat," but otherwise enjoys life outside Chicago, where he lives with wife Jeanne and offspring Rachel and Daniel. . . . **Darryl Dawson** is a cofounder of the M.I.T. Enterprise Forum, also of Chicago, and on the curriculum advisory committee to the Business School at Illinois Tech.

Glenn Sharfin is enjoying fishing in the tropics, except when it interferes with his job as an orthopedic surgeon in Margate, Fla. He's still married to Phyllis, and their children, Andrea ('00), Jackie ('02), and Dan ('05), are growing up fast. . . . **John Clippinger** has been teaching math and physics at Beaver Country Day School for 10 years. Flute playing remains a hobby; more serious was the expectance of their second child, (who will have been born by this writing) this past May. (Nothing like doing columns six months after the fact and six months before publication to teach you the pluperfect subjunctive!)

We secretaries get these little slips full of news, which are filled out by you when you donate to the Institute. This go 'round I got one that said, "Hi, Bob. I still use your picture to shave by." And it was signed.—**Robert M.O. Sutton, Sr.,** Secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

74

It was late at night. A dark, windy night. I was alone in the house, the wind whispering secrets between the trees. Suddenly, a bell rang out! A clarion call to wake the dead. Again! Louder and closer than the first time. Once more within arm's reach it rang! It was the phone. "Hello, Lionel, this is **Jim Gokhale."** The dead do wake! Former Class Secretary Mr. G is recently married to Elizabeth Ann Baker. Jim's company, Gateway Systems, is "doing well." The case of the missing class secretary has now closed. Jim also brings tidings of **Jeffrey T. Mayne** and his wife Kathy, who are moving to Poughkeepsie, N.Y., where he will be in the Department of Biology at Vassar College.

According to a news release from the U.S. Army Corps of Engineers, **Mary Ellen Hynes-Griffin** recently completed requirements for her doctorate in civil engineering from the University of California at Berkeley. Mary Ellen has been with the Corps of Engineers since 1976, and is currently working on safety assessment of major Corps projects, including the seismic safety of earth dams. I wonder if **Thomas Schnetlage** and **Mary Ellen** knew of each other's existance at Berkeley? Thomas has been managing software development for the Computer-Assisted Survey Methods Program there for a year and a half. He went to the People's Republic of China in June to develop a Chinese language version of some Computer-Assisted Telephone Interviewing software he developed. He mentions also that he owns a beautiful Victorian house in Berkeley, and son Paul "really knows his dinosaurs and math." . . . **Janice Gepner** writes to say that she was recently the co-recipient of the award for Excellence in Teaching Secondary School Chemistry from the Northeastern Section of the American Chemical Society. Congratulations! She also mentions her husband Eric Neuman and her two children Mark and Sarah. . . . According to a letter from his father, **Frederick Linderman** passed on in October 1987.

If you folks feel like calling instead of writing, that's fine with me. That's what **John Hixson** did. John is director of the Salem Harbor Community Development Corp. in Salem, Mass. John is living in North Cambridge with his wife Janet, and children Elizabeth and Joseph. John expressed deep satisfaction with his work, directing the redevelopment of run-down and abandoned properties in that historic city. John also mentions **Dennis Dickstein** and **Charlie Hillman** and wants you both to send him the money you owe him. Your Class Notes and Skip Tracer System, at your service. . . . **Peggy Galkowsky** penned a note from Endicott, N.Y., recently. Says she's an advisory engineer in IBM's Federal Systems Unit of their Systems Integration Division. Then there's husband Jan, and son, David. . . . Another note says, "I have just left Monsanto Chemical Co. in Akron, Ohio, after nine years and now live in Chicago. I will be married to Leslie Freemen on May 29, 1988." **Leonard Davis,** mazeltov, and happy six month's anniversary.

The tale of Jayne and **Ronald Todd** is our Adventure Story of the Month. Jayne and Ronald spend most of last year traveling across the U.S., Canada, and some of Mexico. They packed a canoe on the top of their car, and lived out of a tent. "It was truly fantastic," says Ronald. He is now vice-president of engineering at KSA, a consulting company that specializes in placing M.I.T. grads in top-level consulting assignments in the Boston area.

Remember the 15th reunion June 9-11, 1989, and mark your calendars. Let **Steve Bates** of the reunion committee tell you about their plan. "Another milestone, checkpoint, watershed moment, and Fantastic Good Time! We're hoping that you all can make it. The 10th reunion was memorable. This one will be even more enjoyable and memorable but only if you will attend. We want your participation, we need your ideas and we welcome your feedback.

"Here is a brief outline (some are already cast in concrete) of some ideas for the reunion weekend: Thursday evening (concrete) Tech Night at the Pops; Friday (concrete) Technology Day; Friday evening, The Hop: dancing with a live band (the works); Saturday, Clambake/recreation activities; Saturday evening, Living group get togethers?; Sunday, The Boathouse Brunch (on the water), and Class Meeting (concrete) (This should not be missed!)

"If you have questions, please call or write. Don't forget to bring the kids! We haven't determined what this reunion will cost yet but we'll do our best to keep it within reason. Everyone I know has to watch their expenses.

"Start planning to attend now. It's not too early. June will be here before you know it. Get in touch with your 'old' classmates and let's get everybody to come. A lot has happened in 15 years. And the best is yet to come for the Class of '74!

"If you want to help out or send the reunion committee your ideas, please call or write to: Steve Bates, 519 Hayward Mill Rd., Concord, MA 01742 (508) 371-1146. Thanks! We'll be seeing you!"

Hope your winter is a wonderland, and Write If You Get Work.—**Lionel Goulet,** Secretary, 115 Albemarle Rd., Waltham, MA 02154-8133, (617) 899-9694

75

Here's the latest from our fellow classmates. **Allen C. Hart** is currently a Grumman appointee to the Software Productivity Consortium in Reston, Va. . . . **Noel A. Spishak** writes, "I'm still at Boeing in Seattle, and I'm enjoying both. I've now been married for over three years, and Shann and I have a wonderful nine-month old daughter, Lynn, who's just starting to learn the joy of crawling." . . . **Janis C. Weeks** received tenure at the University of California at Berkeley in the spring of 1988. Were that not enough of an achievement, Janis and husband William M. Roberts had their first child, a son, Alex Edward Robert Weeks; he was born on May 6, 1988. . . . **Stewart Roberts** was recently made an associate at A. Anthony Tappe and Associates. He gave an IAP seminar on "H.H. Richardson and Richardsonian Architects" at M.I.T. last January. Also, he and his wife had their second child, Hannah, last September. Congratulations to all of you new parents.

From the May 27, 1988 *Beverly Times* of Beverly, Mass.: **Beverly Herbert** graduated from Gordon-Conwell Theological Seminary. She has been a real estate consultant for many Boston community development projects. As a United Methodist pastor, she hopes to meet housing needs and develop leaders in a church congregation.

David Katz writes, "Karen, kids, and I moved here last July. I am now the sales manager for the eastern region of Qualimetrics, the leading manufacturer of weather stations in the U.S. We are supplying 160 automated weather observing stations (AWOS) to the FAA. An AWOS automatically broadcasts weather information to pilots via

VHF radio using a voice synthesizer. Karen continues to sell Discovery Toys. She is now a manager—her sales last year earned us a trip to Club Med in the Dominican Republic. Robert is finishing kindergarten and getting started with organized sports. Daniel is in preschool every afternoon. We live in Bucks County, Pennsylvania, north of Philly, a wonderful change from Long Island. This is a very good place to live."

Brian G. Lutbader has become a member of the firm of Sitomer & Drexler, P.C. He specializes in real estate development, implementation of asbestos protection programs, construction, and commercial law and litigation. . . . **Alan H. Katz** has relocated with the firm of Montgomery, Barnett, Brown, Read, Hammond & Mintz to 3200 Energy Centre, 1100 Poydras Stree, New Orleans, LA 70163.

That's all for now. Hope you have great holidays. Keep writing.—**Jennifer Gordon,** Secretary, 18 Montgomery Pl., Brooklyn, NY 11215

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We definitely need more news. Please write.

Mathew Breitenberg has been appointed the general manager of planning for Bethleham Steel. He has been with Bethlehem Steel since 1980, when he left a consulting firm doing work for Bethlehem Steel to work directly for them. . . . **Talbot Huff, Jr.** has been awarded an IEEE (Institute of Electrical and Electronics Engineers) medal for contributions to military intelligence systems. . . . **Jeff Jaffe** was also awarded a medal for contributions to routing and flow control in computer networks.

Bob Quirk has moved to Chattanooga, Tenn., where he is working as an engineering specialist for the TVA. . . . **Mike Rismondo** is "currently working for Boeing Aerospace. I got married in 1984, have a 2-year-old daughter, and my wife and I had a son in June 1988." . . . **Edward Kashdan** has "joined the ranks of professional engineers. Also recently joined the consulting firm of Galson Technical Services, serving as the senior environmental engineer in their Philadelphia office." He, his wife, Shanna, and two sons, Zachary and Daniel, relocated from Chapel Hill, N.C. to Horsham, Pa.

Martin Fuchs has "been quite active in Amnesty International over the past four years, sponsoring talks, writing to authorities in a large number of countries, and working with various organs of the U.S. government on human rights issues. Working on behalf of a Ukranian dissident, we created a giant (5 feet by 36 feet) letter to Gorbachev on which we gathered 1,500 signatures. The letter was delivered to Gorbachev at the Soviet Embassy during the summit meeting."

As for your secretary, life moves apace. We are buying a house in Woodmere, N.Y., and will hopefully close by the time these notes reach you. I prefer trading futures. They are far more liquid, and transactions move along far faster. Insofar as fast futures are concerned, the foreign exchange markets have been zipping along. They are not for the weak of heart or wallet. Likewise, coffee, sugar, the grain markets, and bonds. The violent fluctuations in these areas continues to stimulate hedging interest and a certain amount of speculative activity. The elections promise to provide a very volatile trading atmosphere, regardless of who wins.—**Arthur J. Carp,** Secretary, Stalco Futures, Inc., 254 West 35th St., 16th Floor, New York, NY 10001, (212) 736-1960

77

This month we have news and notes from seven of our classmates, including our beloved class secretary. **Deborah Stutman-Brickey** informs us that she has been working for Mead Paper Corp. in the small Ohio town of Bexley since March 1987. Her work involves microcapsules for carbonless paper. Deborah was expecting her first child on July 20, and was also expecting relief from the drought, heat, humidity, and swollen feet. We hope all went well for Deborah, and she will let us know the results of her labors.

Brian Hughes writes, "On June 13, 1988, the ship *Cable Protector* placed the first piece of the PTAT-1 cable in the Atlantic off the coast of New Jersey." Brian co-founded PTAT System, Inc., in 1984 and expects to have the system in service in July 1989. . . . Some news that perhaps more of us can empathize with: **Richard Steinberg** is still renovating his house and hopes to finish before retirement. Richard was recently promoted to associate professor (with tenure) in the Department of Economics at VPI. . . . **Marc Giroux** was promoted to production/engineering manager at Corning Glass Works. Marc has been with Corning since 1978.

We received a "hi to all" from **David Beyer,** who is happily practicing medicine as a radiation oncologist in Phoenix. . . . Your well-read secretary also saw that **Thomas Skopek** published an article entitled "A Method for Specific Cloning and Sequencing of Human hprt cDNA: Application for Mutation Analysis in Humans" in the *Activities* of the Chemical Industry Institute of Toxicology, where Thomas works.

Finally, it is my pleasure and pride to report that your class secretary, **Ninamarie Maragioglio,** gave birth to a daughter, Brielle Maragioglio Hertz, on 8/8/88. Mother and daughter are doing well, and Nina will be back next issue with more class notes.—**Paul Hertz,** Acting Secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153

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As president for the past ten years, I was able to see how much fun it was for **Dave Browne** to be class secretary, so I thought I might look forward to digging up enough news, notes and gossip to fill this column eight times per year. (I hope to enjoy those last-minute frantic searches for material as much as Dave did!)

Dave did a good job to keep us up on the latest news about classmates. Over those years, Dave wrote some 850 column-inches of news (despite the best efforts of the editors to cut him down to size!). This would fill some 32 pages of this magazine. That's incredible!

Reunion was such a fantastic event! It was great to see some faces from the past, like **Mike Melendez.** While at M.I.T., Mike gave some excellent Mexican cooking classes during IAP. The recipes from it were my Mexican cooking bible, until I lost them a few years ago. I was able to ask him for new copies when I spoke to him right before reunion. He brought his family with him, and they were really showing their stuff at the roller skating on Friday of reunion weekend.

Your class secretary organized a Saturday afternoon row for those who wished to jump back into a boat—many for the first time since leaving the 'tute. We had quite a crew: **Dan "Wild Man" Lieberman, Carrick Brooke-Davidson, Paul Malchodi, Jim Pustejovsky, Bob Marcialis, Marc Weiner, Kim Mayyasi, Mike Harlan, Phil Kesten, Sue Coppersmith, Kathy Kielmeyer** (Kathy broke into a grin after the first stroke—she was still beaming at Sunday Brunch!), **Jill Kern, Alice Cowan Campbell, Frances Scovil, Steve Kirsch, Kelly Pan, George Drakeley,** and **Cindy Cole. Barb Ostrom,** and yours truly drove launches so family and friends could watch, while **Diane Curtis**—a rower by association—took pictures.

Reunion Chairman **Karyn Altman** also organized a women's volleyball reunion that included **Sheila Luster, Sue Coppersmith, Lisa Albright, Celia Barry,** and coaches Bob Cassels, '76, and Dave Castanon, M.A.'76. (Sue Coppersmith, participating in both rowing and volleyball events, gets our reunion's "best all-around athlete" award.)

The electricity was unbelievable all evening at the Saturday evening dinner/dance held at the Charles Hotel in Harvard Square. It was a very elegant and fun event. **Ruth Shragowitz** claims to have noted numerous "rekindled embers" between classmate couples that she hopes to monitor over the next five years. Ruth was able to compile the only complete list of classmates who attended reunion—some 130 in all!

Our reunion gift was presented over the reunion weekend. Since 1983, our class has raised over $119,000 for the Class of 1978 Student Aid Fund. This is a very impressive showing. Congratulations to past reunion gift chairman **Milton Roye** and to past class agents **Diane Curtis** and **Dave Woodruff.** Through the mails, you'll be hearing more about the Student Aid Fund and the students who are receiving grants from it.

Gene Allen and his wife Kathy came up from the D.C. area where Gene was a member of Sen. Byrd's staff. In July, Gene moved to Meadville, Pa., to direct the National Institute of Flexible Manufacturing. The NIFM is a private, non-profit "teaching factory" being established to promote computer integrated manufacturing techniques. Gene is really psyched about this undertaking. (If you know Gene, this means really, really psyched!)

Rich Ilson was promoted to director of Distributed Publishing Technology at Interleaf, Inc. a leader in the publishing software business. **Kirk Reistroffer** was named an Interleaf Fellow, in recognition of his extraordinary technical contributions to that company. Kirk was living in Walnut Creek, Calif., but is scheduled to return to Interleaf's Cambridge headquarters.

Matt Lieff received the "David Wolochow Award" from the Canadian General Standards Board for winning the CGSB international essay contest with a paper on the "Benefits of Consensus Standardization to Small Business: A View from the USA." Matt now lives in Cheltenham, Pa. working for the ASTM.

From the North Country, we hear from **Todd Buikema**: "I'm working for ARCO Alaska as a senior engineer in Prudhoe Bay. My wife, Linda, is busy chasing after our three-year-old son Lindsey. We're enjoying life in Alaska, especially the skiing and the beautiful terrain. But we're also looking forward to getting back to the lower 48."

Heather Hazard writes of a baby due around Thanksgiving. She expects to finish her doctoral work at Harvard Business School by September 1988, and then will pursue post-doc studies at the Business School. Heather sends special thanks to classmates **Marc Truant** and **Stew Landers** "for being such awesome guys."

Gary Asakawa writes that he's a principal electronics engineer at Digital Equipment Corp. in Colorado Springs. He's a lead designer of analog circuits for high-capacity hard disk drives.

Further south, **John Jaynes** writes that he has "survived Dallas for three years—the longest I have been in one place since graduating." John was promoted to manager of marketing planning at American Airlines (the only airline in Dallas). John writes that he is enjoying his two daughters, four-year-old Jessica and one-year-old Jennifer.

Alice (Cowan) Campbell was at reunion and rowed in one of the boats we got together. She's still got her technique—it's just like riding a bicycle, they say. Alice relayed that **Steve Webster, Steve Pratt,** and she are all active on the board of the M.I.T. Club of Minnesota.

I received a nice note from **Dave Woodruff** who lives with his wife Denise and daughter Natalie in Danvers, Mass. Dave has been an officer in M.I.T.'s Industrial Liaison Program for four years now and still enjoys it. His responsibilities center on companies in Japan, so he has occasion to travel there.

Alan Marcum writes that he's moved from Sun Microsystems to head up the Technical Support Organization for NeXT, Inc. (the latest venture of Apple Computer founder Steve Jobs). He's busily gearing up this new group with NeXT's products due out soon. Alan and his wife live in Palo Alto when not commuting to Ashland, Oregon, to see performances of Shakespeare.

Diane Curtis and I have been leading rather

full lives lately. Since June we've been foster parents to now-six-month-old Thomas, I have decided to make the U.S. National Lightweight team next summer (you're never too old...), and our PC applications consulting firm, The Cadence Group, is extremely busy. BUT there's always time to hear from YOU for our next Class Notes column. Drop me a line today!—**Jim Bidigare,** Secretary, 659 Green St., Cambridge, MA 02139

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I am writing this on the 42nd straight day of a heat wave (today's high was 97 degrees!) It's hard to believe that in a few short months, we will be wearing winter coats again. Ah, the joys of life in the Northeast!

First, a few words from those classmates smart enough to have moved to more temperate climes—California. **Anne Michon Westbrook** is living in Los Altos with husband Scott Westbrook, '78. She writes, "After five years and being project manager on three versions of PFS:PLAN at Software Publishing Corp. in Mountain View, I left in August 1987 to start my own software company. However, the stock market crash in October 1987 put an end to that venture. So instead, I'm gardening, reading, traveling (to Massachusetts and Europe) and just enjoying life while Scott pays the bills. After nine months of the Good Life, it looks like I will probably rejoin the work force soon." . . . **Andy Hegedus** had a busy year last year. He married Katherine Boshkoff (Smith '81), bought a house in San Francisco, and finished his Ph.D. in materials science from Berkeley. He is now working as a senior research chemist in ceramic composites for Hexcel Corp. . . . **Sandra Viarengo** is involved in the planning and startup of Intel's new class 1 submicron development facility in Santa Clara. At press time, she was looking forward to a long vacation in September and October, during which she planned to visit Nepal and trek the Annapurna circuit, as well as visit Bangkok. . . . Even **Chuck Keilers** is westward bound. Since 1981, he has been working on naval reactor shield design. He has just completed his part of the design for the new Seawolf Class Attack Submarine (SSN21). Now, after 13 years on the East Coast and nine years in the navy in Washington, D.C., he's leaving all three for California. Keep us posted, Chuck.

Meanwhile, back in the Boston area . . . Steven Gordon founded Intelligent Automation Systems, Inc., in 1987, a consulting company specializing in manufacturing automation. Their current activities are in high-speed computer-controlled machine design, flexible assembly systems, and high-precision vision systems. He lives in Malden. . . . **Gerald Melsky** married Mary Ann Partridge, S.M. '82, in September of last year, and they are living in Lexington. Gerald is working for a ten-man startup company that makes implantable medical devices. . . . Our class agent, **Rick Kovalcik,** was married on April 9 to Susan Mozzicato (Amherst '80). The newlyweds honeymooned in Hawaii and are now living in a house in Waltham. Rick urges all classmates to send in their ideas about the 10th reunion class gift!

Ron Dictor writes that he is still enjoying life as a Michigander (does that mean that his wife is a Michigoose?). "My three kids keep me busy, especially my 18-month-old daughter, who keeps beating up on her 3-year-old and 7-year-old brothers!" . . . **Steve Bridges'** wife writes, "Steve and I have just returned from a six-month stay in Ludwigshafen, West Germany, where he was a corporate informational delegate for BASF. This was quite an experience for our entire family, which now includes a daughter, Lauren Kelly, 5, and a son, Connor Joseph, 1." . . . **Diane Peters** and Victorio Hoskins, M.C.P. '81, were married in July 1987. Diane received her M.B.A. from UCLA last year as well and is with the international real estate development firm of Olympia & York. . . . I dropped in at my local Singer Sewing Machine store recently, where **Susan Silverstein**'s father works. He told me that she is now married to a fellow lawyer and has relocated from Bath, N.Y., to the nearby town of Victor. Hey, Susan, do I have to break my sewing machine to find out what you've been up to? Write soon!



Jon Swanson

Jon Swanson, has become a supercomputer consultant at the University of Mississippi. Jon has a doctorate in organiz chemistry from Berkeley and was formerly a research chemist with the Seiler Research Laboratory at the U.S. Air Force Academy. In his new job, he will assist and advise professors and researchers on the operations of the Cyber 205 Supercomputer, which is available to users statewide through the Mississippi Center for Supercomputing Research.

That's all the news for now. Keep your ears and eyes open regarding our upcoming reunion, and I hope to see you *all* there.—**Sharon Lowenheim,** Secretary, 500 E. 63 St., Apt. 18B, New York, NY 10021

80

Hello to all class of '80ers (and families!) from hot, steamy Cambridge! I'm hoping that writing these notes for the November/December issue will put me in a cool state of mind.

First item out of the mailbox this month is a short article about **Dennis W. Essa,** who co-created a software product that provides a computerized version of Tarot cards. The product is offered by Emin Arcadia, a foundation for human development. Anyone tried it? The article states that "Tarot cards should not be used for fortune telling, but for getting to the essence, the truth of what a subject is all about"—which was news to me. . . . **Yet-Ming Chiang** has been promoted to the position of associate professor of ceramics in the Department of Materials Science and Engineering (at M.I.T., of course). His work focuses on structure and structure-property relations of both structural ceramics and electronic ceramics.

The University of Chicago Press has recently published a book by **Mark C. Baker** entitled *Incorporation: A Theory of Grammatical Function Changing.* Mark received his Ph.D. in linguistics from the Institute in 1985 and is now an assistant professor of linguistics at McGill University. . . . **Hrvoje Petek** wrote that he's been appointed to the position of research associate at the Institute for Molecular Science at Myodaiji, Japan. He intends to stay there for the next two to three years studying femtosecond (?) spectroscopy. (Is that right? Had some trouble with the handwriting.)

On the relaxation front (well, somebody's got to do it!), **Christopher Hudson** wrote that he was planning to sail a lot on Lake Michigan this past summer. (So, how was it?) . . . **Sam Nixon** writes that he's successfully serving as the project leader for automation security at the Federal Reserve Board in Washington, D.C. He's also involved with the development of national professional networking organizations. At a recent conference in New Orleans he presented a professional paper on automation security in large organizations.

Deborah August started her residency in general surgery in the UMass Coordinated Programs in July. She recently graduated from UMass Medical School. In her spare time, she grows cattleya and phalaenopsis orchids in her apartment in Worcester, Mass. . . . Meanwhile, **John Bard** is finishing up (or maybe has by the time you read this) eight years in the Air Force, and is planning to make (or has made) the transition to civilian life. Since he was just starting to job hunt at the time he wrote, the details of his career change are still uncertain.

Lots of baby news this month as well: **Howard Gans** and his wife, Hillary, had their second son, Jared Henry, March 4. In April Howard received his Ph.D. in aerospace engineering from the University of Michigan. . . . On April 26 **Brian E. Clouse** and wife Martha had a daughter, Sarah, their second child. Brian is a design engineer with GE Aircraft Engines in Lynn, Mass. He and his family live in Saugus, where they have numerous home-repair projects under way.

Then there's Katie and **Ken Turkewitz,** who had a son, Avidor Reuben, at 9:35 p.m. on May 4. He weighed in at 8 lbs., 10½ oz.—21 inches long. . . . Somewhat lighter (7 lbs., 6 oz. to be exact) was Sean Kevin Patrick, first child of Mike ('79) and **Diane Patrick.** Sean was born June 19. Diane writes that fatherhood is suiting Mike very well (I guess he doesn't need much sleep!) and that she took a six-week leave from her medical practice to be with the baby.

Finally, some news written up for me: "**Jim Showalter** has been active in starting things. Jim 'spun out' of his former company (BITE) last fall with five fellow employees, including a former BITE president, to create SIGMA PLUS, an engineering consulting firm in Fairfax, Va. Now at 10 people, SIGMA PLUS performs operational suitability studies and analyses in the DoD sector. Jim and his wife, Kerri, have also been starting things on the home front with the birth of Zachary James Showalter (8 lbs., 9 oz.) on January 15."

That's all for now folks. Looking forward to hearing from some of you next month!—**Kate Mulroney,** Secretary, 256 Hampshire St., #3, Cambridge, MA 02139

81

Hello everybody. Happy Holidays. **Andrew Michael** writes in to tell us that 1985 was his most eventful year. He married Stephanie Ross, also a geophysicist and received his Ph.D. from Stanford University. Both Andrew and Stephanie are working for the U.S. Geological Survey in Menlo Park, Calif. They recently purchased a home in Half Moon Bay, near the Pacific Ocean. . . . **Marc Chelemer** will be on the West Coast by the time this column appears attending the M.B.A. program at Stanford Business School. He plans to focus on international business. Before heading west, Marc and his wife Carol planned to take a "real" honeymoon of about one month in Australia (about the only way to get relief from this hot summer!). . . . **Concetta LaMarca** writes that she is currently pursuing a Ph.D. in chemical engineering at the University of Delaware in addition to studying and performing modern dance in Delaware and Philadelphia.

Guido Defever has settled in Union Lake, Mich., after job stints on both the East and West Coasts with his wife Lynda and their two children, Erin (3) and Andrew (1). He is currently heading up the combustion design and analysis area at Williams International, a small turbine engine company. Starting this fall, Guido will be juggling school, work, and family when he continues pursuing his "elusive graduate degree" in aero at the University of Michigan. . . . **Richard White** is still working for Hewlett Packard, having moved from California to Pennsylvania. He and his wife were expecting a child in July. . . . **Dave Slobodin** is working at Greyhawk Systems, a small company in Milpitas, Calif., specializing in products based upon liquid crystals. He enjoys the change after working two years at Polaroid.

In addition, Dave recently spent an enjoyable vacation rafting in Utah and hiking in the Rockies.

That is about all for now. Please keep writing.—**Lynn Radlauer Lubell,** Secretary, 216 Beacon St., Boston, MA 02116

82

Happy holidays to one and all. My present is that, after almost a year on the job, you've finally started to write.

Mike Colucci dropped a postcard from the home of **Galen Seitz** in Tigard, Oreg., just outside Portland. At the time (last August), he and his wife, Teresa Cichello, '84, were three days into a month-long bicycle trip from Seattle to Colorado Springs. Mike is working on consumer products research for Dow Chemical in Midland, Mich.; Galen is working for Tektronix and would love to have more visitors, with or without bicycles.

Gerard Weatherby, after agonizing over which correspondent he should write to for months, finally wrote (to me) to report that he is still in the navy, working as an instructor of combat systems at the Naval Submarine School in Groton, Conn. He also reports that he accepted another job last spring: "I work for a young lady by the name of Kathryn Joan Weatherby in a position as father. I am learning rapidly and mastering many skills, including advanced diaper changing, both with pins and plastic, intermediate stroller operation, beginning making funny faces, and singing Know an Old Lady Who Swallowed a Fly countless times." Gerard and his wife, Julia Goddard Weatherby, '84, bought a house in East Hampton earlier this year.

Another sometimes compatriot at *The Tech*, **Aaron Rapoport,** reports that he and his wife, Debbie, Wellesley '84, had a daughter, Julie Rebecca, on June 1. Aaron is in the last year of residency in internal medicine at Strong Memorial Hospital in Rochester, N.Y.

As always, there are new Ph.D.'s in the class. **Catherine Briasco** received hers in chemical engineering from Stanford in March. She is currently a NATO postdoctoral fellow, working at the Universite de Technologie de Compiegne, about 60 kilometers northeast of Paris. . . . **Charles Palmer** received his Ph.D. in organic chemistry from the University of Illinois in May 1987. Chip is now working for Du Pont in Delaware. He reports that "life after grad school has been very nice"—he's learned to windsurf and ski in the past year. Chip would like to hear from old Second East friends.

I'm not the only member of our class to wind up in the Chicago area. **Daniel Rubin,** now happily married, is going to business school at Northwestern University.

Remember to drop your class secretaries a postcard or note while you're enjoying your holidays and vacations. You can contact East Coast correspondent **Linda Schaffir** (18 Prospect Ave., Apt. B-2, Norwalk, CT 06850), West Coast correspondent **Michelle Gabriel** (656 S. Fair Oaks Ave., D-211, Sunnyvale, CA 44086) or me.—**Stephanie Pollack,** 722 W. Roscoe St., No. 204, Chicago, IL 60657

83

Most of our information on classmates this month comes from people who took the time to write while giving money to M.I.T. It turns out that by the time the cards come in from the alumni office, we are already writing the column that will appear six months after you send in your news. So feel free to write and tell us what you think you will be doing in the future. . . then you can see if you were right. For more timely reporting, please send news directly to the address at the end of these notes.

First, news from several of our class doctors. **John Shim** reports that he is about to begin his orthopedic surgery residency at Albert Einstein and Montefiore Medical Center. . . . **Steve Kim** writes that he is currently a resident in general surgery at Barnes Hospital at the Washington University School of Medicine in St. Louis. . . . And well on her way to becoming a doctor, **Agnes Huang** has just finished her second year of medical school at the University of California at Davis. Agnes also reports that **David Kane** continues his Ph.D. thesis in electrical engineering at Stanford.

Also reporting from the West Coast is **Kendall Morris.** "Kritter" was appointed lecturer in natural science illustration at the University of California at Santa Cruz during 1987. . . . **Ron Fearing** writes that he finished his Ph.D. at Stanford, and is now continuing his education as an assistant professor at the University of California at Berkeley in electrical engineering and computer science.

In this month's believe-it-or-not department, **Jeffrey Muss** has found his calling in life as a rocket scientist. He works for Aerojet Technical Systems in Sacramento, and recently was back in Boston to give a talk on rocket science to a group of fellow rocket scientists. Jeff's cohort Marilyn Bryant generally enjoyed her visit, but was stunned to find out that neither Dino's nor Buzzy's turned out to be the five-star restaurant that Jeff had been telling her about.

Our long-distance-letter-of-the-month award winner comes from **Mark Clardy.** Mark is currently working for Harding Lawson Associates on geotechnical investigation in the South Pacific on the Island of Tutuila, American Samoa. Mark notes that the geoscientists among us will recognize that his work requires frequent travel within the so-called Ring of Fire.

Back on the East Coast, **Jan Peter Fasse** writes from Cambridge. After M.I.T. he worked in the Genetic Engineering section of the U.S. Patent and Trademark Office. He then obtained his J.D. at the National Law Center at George Washington University in Washington, D.C. Since October 1987 he has been working at Fish & Richardson, an intellectual property law firm in downtown Boston. He specializes in litigation and biotechnology patent prosecution.

David Webster writes that he is living in Cambridge, restoring a Victorian home, and running a design/build firm. . . . **Gary Allen Churchill** received his Ph.D. in bio-statistics from the University of Washington. He and his wife, Rachel, will live in Heidelberg, Germany, where he will be working at the German Cancer Research Center.

Steven DeFalco is returning to New York to work for McKinsey and Company. Steve spent the last two years at Sloan, and he and his wife, Rosemarie, are proud parents of year-old Tommy DeFalco. Like his father, Tommy prefers his liquid meals at the Cask on Thursday nights.

As for me, it's back to school. It's what all the professional students are doing. Fortunately, I'm about to spend a week in Aruba to adequately prepare myself. Please keep the cards and letters coming—it will give me a pleasant diversion from case studies.—**Jonathan Goldstein,** Secretary, 2 Soldiers Field Park, #201, Boston, MA 02163

85

Marie Cunningham left her company in Vancover, Wash., and is now living in Milford, Conn., and working for Vitramon in Monroe. She lives one block from the beach and near **Rich Mastrangelo.** In Vancouver, her dart team was third in the region, and the softball team was first in the city league. Now she is getting involved in sailboat racing and plans to enroll in a local graduate program. She has also been in touch with Lennart Moller, '84. He is attending San Francisco State working towards his B.S. in chemistry until he is accepted to med school.

And, still more weddings! **Janice Eisen** married Ken Meltsner, '83, former conservative Gumby, in

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June 1985. After graduation, she worked for the Massachusetts Department of Public Welfare as a budget analyst. Ken finished his Ph.D. in materials science and engineering in November 1987, and they moved to Schenectady. Ken is working for GE, and Janice is trying to make a go of writing. She hasn't sold any fiction yet but has a book review column in a sci-fi magazine.

Megan Donahue and Mark Voit (Princeton '83) were married on May 28 in Boulder, Colo. The wedding was attended by **Mike Bernard** and Tim Magee, '84. Mike is working for TRW in Los Angeles, making lots of worthless LA dollars, and Tim is doing OR research at M.I.T. Megan and Mark are both doctoral candidates at University of Colorado in astrophysics. Megan says that unfortunately she's taken up skiing in the winter and road racing (10 and 5 kilometers) in the summer. Add to that bass playing for a local band, appropriately names "No Profit," and you have someone who is far too busy to graduate!

Since graduation, **Loren Ann Frost** has been a graduate student at Cornell, first in linguistics and now in psychology. She switched after two years (fortunately the work she did was good for a minor in cognitive studies) and plans to complete her Ph.D. in 1991. She is also engaged to Glen D. Crawford (Caltech '85) and they plan to be married sometime in 1990. Loren claims that even though he hails from "that other school" he is pretty normal and has a great sense of humor. They have already set up housekeeping and have a cat (Rabi). Glen is a physicist and is working towards his Ph.D. at Cornell.

Last New Year's Day, a bunch of French House alumns converged on Boston for a reunion of sorts. **Jon Morrow** organized a newsletter address list. Ed Curran '86, Hienz Kochling, '84, Jeff Rothman, '84, and **India Starker** are all living in Allston, and they hosted the New Year's party and breakfast. The next night a bunch of them had dinner at McCormick as guests of tutor Francie Gurney, '86, also a French House alum.

Kathy (Geary) and Eric Balles, '80, parted with their life's savings to purchase a house in North Reading, Mass. Kathy works at General Electric Aircraft Engines as a manufacturing engineer. She would like to dispell any rumors that she is pregnant. Eric and she attended a virtual M.I.T. reunion at the June 9 wedding of Mimi Ing, '87, and Frank Slaughter, '84. They shared a condo rental with **Alysa-Ann Kodisch,** who is living with **Muffy Hess** in Brooklyn and working in Manhattan as a headhunter. **Pauline Lui** and **Tom McCormack** were also sharing the condo. They saw Evie Vance, '86, who will be joining potential fiance, **Dan Heimerdinger** in Washington D.C. **Bruce Maggs** was also there. He and Ginny Loop, '88, were married on July 9. Other classmates who attended were **Kris Dinsmore, Rich Corkran, Keith Daly,** and **Ollie Patterson.** They all had a great time!

Kathy also writes that **Danielle Sherwood** began attending Harvard Business School this fall. . . . **Chris Woelfel** just completed the last leg of her post-Peace Corps around-the-world tour. "Steffens, **Lisa Steffens''** is still with the CIA in Washington, D.C. . . . **Tom St. Louis** is working for Pfizer in Groton, Conn., and is heavily involved in AZT research. . . . **Billy Coleman** is living on Beacon Hill working for Cooper & Lybrand. . . . **Bea Garcia** is working for Hughes and living in California.

On the West Coast, **Bill Messner** is attending Berkeley, where he is working on a master's in mechanical engineering, after working for two years after graduation. For the past year he was roommates with Billy Gordon, '87, and Laura Lesniewski, '84. They were working on masters' in architecture but have taken time off to work and travel. Somehow his apartment has become the center of M.I.T. activity. During the weekend of June 18, ten people were staying there, nine of whom were M.I.T. students. They included himself, Megan Smith, '86, Billy Gordon, '87, Cathy Kim, '88 (swim captains 1985-88), Massimo Russo, '88, Catherine Cherubino, '88, Margaret Minsky, '77, Yong Hahn, '86, and Derek Agui, '87 (his new roommate). The highlight of the weekend was a party on the 18th attended by everyone mentioned and Bill Stafford, '88, Seymour Liao, '91, Dana Takaki, '87, Maria Golianu, '87, Bob Brodersen, '87, Susan Zarzeczny, '87, Adam Malamy, '84, Bruno Leung, '84, Ron Ried, '84, Cary David, '88, David Sungster, '87, Todd Cass, '85, and others. That weekend he also saw Anne Fricker, '86, Brian Harvey, '69, **Scott Fisher, Steve Gano, Max Behensky, Doug Milliken,** and **Susan Brennan.**

Andy Renshaw is entering his fourth year of Harvard Med School, and **Dave Sherman** continues to work at Rogers Corp. while living in Pomfret, Conn. . . . **Jim Hutchinson** now lives in Wakefield, Mass., and works at Thinking Machines. He and Nancy Defeo, '84, are still an item. . . . **Richard Weaver** is working for Procter & Gamble as a systems analyst. He is having a good time in Cincinnati and claims that, contrary to popular belief, it's not Hicksville. He's around M.I.T. twice a year pre-recruiting for P&G.

Barry McQuain started his own business—FinTech, a financial technologies business. He is living in Chicago. . . . **Ann Dalton** is working on PREDICT, a program that predicts the frequency at which *Voyager* will broadcast when it encounters Neptune's atmosphere. Ann works at the JPL in Pasadena and has several noisy Caltech grad students for neighbors. . . . **Bill Bruno,** former long distance runner on the track team, passed the Ph.D. qualifying exams in biophysics and expects to finish his thesis studies by next year. . . . **Teresa (Hohol) Bowers** was awarded a NSF-funded visiting professorship at Harvard in the area of earth science. Her research is in the area of geochemical consequences of fluid immiscibility on one deposition.—**Stephanie Winner,** Secretary, 1026 Live Oak Dr., Santa Clara, CA 95051

86

Adam Bernard writes from Troy, Mich., that he will be a student at Harvard Business School this fall on a General Motors fellowship. Adam recently visited the 'Tute and noticed that a great many things have changed, including the availability of Dove Bars and Haagen Daaz ice cream at Walker cafeteria and a new phone system, complete with a digital central message center. Adam says rumor has it that the Smithsonian is interested in obtaining our Centrex for historical reasons. Finally, he says there may even be a third sorority developing. He also mentions that **Yona Kaplan** is living in Troy and working for EDS.

Carlos Sanchez is a propulsion analysis engineer with General Dynamics, Fort Worth Division. He married Rosa Loor in April 1987, and they were expecting their first child this past July. He plans to continue his education with an M.S. in Aero/Astro at University of Texas at Austin in September. . . . **Bob Renz** recently graduated from Stanford with an M.S. in Aero/Astro (actually it was last December). He now works for Boeing Aerospace as a performance engineer in flight technology. He is currently living in Seattle with two other Boeing engineers. . . . **Douglas Macleod** went into the Peace Corps to teach physics and math. He will be stationed in the Fiji Islands. . . . Ensign **Peter Ulrich** reported for duty with Training Squadron 24, Naval Air Station Chase Field, Beeville, Tex. . . . **Tracey Keats** is rumored to have recently become engaged. . . . **Jose Ferrarer** and **Jene Spears** are officially betrothed. Both of them have been doing graduate study at Stanford University.

Pam Murphy, Wellesley '86, ran into **Jim Wilkerson** in San Francisco over 4th of July. Jim is finishing up his pilot training at Kastle AFB, Calif., and will be reporting to duty in Arkansas later this year. . . . **Sonya Sakai, Greg Harrison** and myself were promoted to first Lieutenants in the air force. Now we're ready for increased responsibility. Oh boy. I will be attending a meeting next week at the Marshall Space Flight Center in Huntsville, Ala., with Lt. **Marilyn Oberhardt.** She is currently at the Air Force Geophysics Lab at Hanscom AFB, Mass.

That's it folks. I can't write about what I don't know.—**Mary E. Cox,** Secretary, SD/CLFP, P.O. Box 92960, Los Angeles AFB, CA 90009-2960

87

It's 2:30 a.m., and I'm writing my column for the *Review.* . . . I feel like I'm in school again. Congratulations go to **Gregory Strangeways,** who is now senior office assistant IV for Purchasing at Draper Laboratory. . . . **Edie Erlanson** has graduated from Caltech with a master's in aeronautics (his loyalties are still with M.I.T.) and is now working for Boeing Commercial Airlines (Renton Division).

Edie sends lots of good information. . . . **Andrea Ghez** is continuing her studies at Caltech. She's in for the long haul—a Ph.D. in physics. Andrea spent a week in Corsica for a conference this summer. . . . **Stacy Weinstein** and Linda Roebeck, '86, are at JPL, and **Bob Acker, Mike Cassidy, Joe Bush,** and **Tanya Pemberton** are at Hughes. Edie spent some time traveling and visited **Alex** and **Luli Tellez** in Melbourne, Fla., on the occasion of their one-year anniversary (July 25). They are the happy expectant parents of a baby girl in late October. So far, her name will be Lauren. Congratulations are in order! Alex is enjoying his work at Harris Corp., and learning computer consulting on the side. They have recently moved into a spacious two bedroom apartment with an additional loft area (with skylights, too!) to allow for "growing room." . . . **Simon Lie** is working on his master's at M.I.T., primarily in composite structures. He is fortunate to have three good UROPers working for him this summer and is looking to finish his thesis in time for February graduation. . . . **Steve Day** is in the M.D./Ph.D. program at Johns Hopkin University, living in an area of Baltimore close to the Inner Harbor. His work this summer is with NMR, within the Oncology Department.

Andrew Bein writes to say hello to all his classmates. He now works for New York City's Public Development Corp. as a project manager for the new Madison Square Garden and a headquarters for Drexel Burnham. Previously, Andrew was working for the overall budget office of the city, overseeing all of PDC's projects. Andrew is taking classes at NYU and Columbia and lives uptown in Washington Heights.

Terry C. Huang writes from Ann Arbor, Mich., to update the status of a few '87 graduates. . . . **Kip Fern** just finished the VI-A program in electrical engineering and will be working for Oracle Corp. in California. . . . **Kelvin Phoon** will be starting work for Booz, Allen and Hamilton in Maryland.

Bridget Fitzpatrick writes from East Lansing, Mich. She is in graduate school studying chemical engineering at Michigan State University. Bridget is studying "how to turn trees into gasoline." Technically speaking, she is working on "hydrogen fluoride saccharification of lignocellulosic residue." She says, "After speaking with a bunch of people about grad schools, in Course 10, the general consensus seems to be that there is no place like home. You aren't in Cambridge anymore, Dorothy!) I guess that you have to leave M.I.T. to truly appreciate the real world. A bunch of people have dropped out of various programs, and a bunch of people are just complaining a lot. I imagine that some people are happy with grad school, but I haven't heard from them. I guess we just didn't realize how good we had it at M.I.T. (Do you hear that Dr. Mohr??)"

I guess I'm not the only one who misses M.I.T., but I have to be careful about who I admit it to. That's all I've got for now. Please keep those letters coming!—Keep having fun! Don't forget, my new address is—**Stephanie Levin,** Secretary 41 Prentiss St., Cambridge, MA 02138, (617) 547-6673



COURSE NEWS

I CIVIL ENGINEERING

Wilbur L. Hankey, S.M.'53, is the author of a new volume in the AIAA Education Series: *Re-Entry Aerodynamics.* The four chapters deal with re-entry flight regimes, flight mechanics, hypersonic aerodynamics, and re-entry heating. Hankey is associated with the Air Force Flight Dynamics Laboratory at Wright Patterson AFB. . . . From Mexico City **Alejandro Barrios Tellez,** S.M.'82, reports that his SYSTEC construction consulting company founded two years ago is "offering turnkey projects with great success." Barrios Tellez is in his sixth year of service on the Board of Directors of the M.I.T. Club of Mexico, and he was chairman of the club's 40th annual fiesta in Guanajuato.

Major new jobs for five alumni:

□ **Anthony C. Centore,** S.M.'62, is vice-president of Parsons Brinckerhoff Quade and Douglas, Inc. He is a senior structural engineer and manager of business development in the firm's northeast region, based in Boston. Among current assignments, he is project manager for rehabilitation of the Cape Cod Railroad from Attleboro to Hyannis, Mass., for survey and rehabilitation of 300 bridges for the Massachusetts Bay Transportation Authority, and for emergency rehabilitation of 12 bridges for the Connecticut Department of Transportation.

□ Formerly national technical manager for the Plyroof Division of Plymouth Rubber Co., Canton, Mass., **Stephen J. Condren,** S.M.'75, is now vice-president of Cooley Roofing Systems, Inc., Pawtucket, R.I. He's in charge of Cooley's field engineering and technical services.

□ **Kenneth F. Reinschmidt,** Ph.D.'62, has been advanced from vice-president of Stone and Webster Engineering Corp., Boston, to president of its Advanced Systems Development Services Division.

□ As of last May, **Max Ulrich,** S.M.'51, is president of the Ward Howell International Group, New York; he was formerly chairman and CEO of Ward Howell International, Inc., where he will continue to serve in a senior advisory post, according to the *New York Times.*

□ **Guillermo J. Vicens,** Ph.D.'74, has a new title at Camp Dresser and McKee, Inc., Boston: formerly vice-president, he has been advanced to senior vice-president.

Moritz O. Bergmeyer, S.M.'66, has done what only a few have the courage to do—a radical mid-career change. He abandoned his architectural practice, Bergmeyer Associates, Inc., Boston, for the Grand Targhee Ski Resort on the Idaho-Wyoming border near Grand Teton National Park. It all happened after he fell in love with the place during a ski vacation last winter: "I liked it so much I bought it," he told an interviewer this spring. Under his ownership, Grand Targhee will be transformed from a winter ski spot to a year-around resort.

To recognize his work in solid-waste disposal, wastewater treatment, and environmental risk assessment, Union Carbide Corp. has named **Richard A. Conway,** S.M.'57, a senior corporate fellow. Conway works in the company's Central Research and Engineering Technology Department, South Charleston, W. Va. Conway is a member of the National Academy of Engineering, and he holds *Chemical Engineering* magazine's Personal Achievement Award (1987) for his work with professional, research, and government organizations. . . . **Carl F. Long,** S.M.'52, a longtime member of the Dartmouth faculty, is candidate for chairman of Section M: Engineering of the American Association for the Advancement of Science. If successful, Long will take office in January for a three-year term.

Henry D. Tomlinson, S.M.'55, died of cancer on June 16, 1988, after a brief illness. He was a member of C. Vargas and Associates, Ltd., Jacksonville, Fla., and earlier had been vice-president of Reynolds Smith and Hills, Jacksonville.

II MECHANICAL ENGINEERING

To Professor **George Chryssolouris** of M.I.T. went the task of organizing the program for ASME's "Manufacturing International 88," the society's first-ever meeting devoted exclusively to manufacturing issues. More than 400 engineers came to Atlanta from throughout the world, including two members of the M.I.T. department—Professor **Timothy G. Gutowsky,** Ph.D.'81, who led a symposium on manufacturing composites, and Professor **Kamal Youcef-Toumi,** S.M.'81, who had a session on robotics.

Foxboro Co.'s 1988 Bristol Fellowship Award, which consists of $10,000 worth of stock in the company, went to **Peter Hansen,** Sc.D.'60, of the Foxboro technical staff. In 20 years with the company, Hansen has been responsible for key technical advancements in a number of instruments.

Adrian Bejan, Ph.D.'75, will receive ASME's Gustus L. Larson Memorial Award at the winter annual meeting in Chicago at the end of November. It recognizes "outstanding achievement in mechanical engineering within 10 to 20 years following graduation." Bejan specializes in heat transfer and thermodynamics; he is professor of mechanical engineering and materials science at Duke University. . . . ASME's Burt L. Newkirk Award was given to **Kryiakos Komvopoulos,** Ph.D.'86, assistant professor of mechanical engineering at the University of Illinois, Urbana, at a tribology conference in October in Baltimore. The award is for contributions to tribology through research and development by an engineer under the age of 35.

Tau Yi Toong, Sc.D.'52, has retired to the rank of professor emeritus of mechanical engineering at M.I.T. Toong entered the Institute as a graduate student with an engineering degree and several years of experience in Shanghai, and his teaching career began even before he finished his doctorate. He's best known for important research contributions in the fields of magnetogasdynamics and supersonic combustion. He has also been a leader in the nation's Chinese-American community.

From Little Oakley, Harwich, England, **Reginald L. Gott,** S.M.'85, reports that he is project executive for Portals Holdings PLC, developing manufacturing and corporate strategies for the company's Engineering Division. For two years after leaving M.I.T. he worked in West Germany on computer-integrated machining systems—mainly for the U.S. market.

To **Nam P. Suh,** S.M.'61, who's on leave from the M.I.T. faculty to be assistant director for engineering at the National Science Foundation, an honorary L.H.D. degree from the University of Lowell. . . . **John Psarouthakis,** S.M.'62, founding president and chairman of J. P. Industries, Inc., Ann Arbor, Mich., is now a trustee of Carnegie Mellon University, Pittsburgh. He's also a director of Michigan's Industrial Technology Institute; chairman of the Advisory Board to the Center for Entrepreneurship and a member of the College of Business Development Board, both at Eastern Michigan University; and a member of the Visiting Committee to the School of Business Administration, University of Michigan.

Edward Bernardon, S.M.'84, is now assistant program manager in the Industrial Automation Division, Draper Laboratory, Cambridge. . . . Formerly vice-president of Sequa Corp., New York, **Henry Dyner,** S.M.'63, is now senior vice-president at Sun Chemical Corp., Fort Lee, N.J. . . . **B. Gordon Watkins, Jr.,** S.M.'53, has left Wiley and Wilson, Lynchburg, Va., where he was vice-president, to join four partners in founding the Greenwood Partnership; based in Lynchburg, the firm specializes in industrial, graphic, and architectural design for national and international clients.

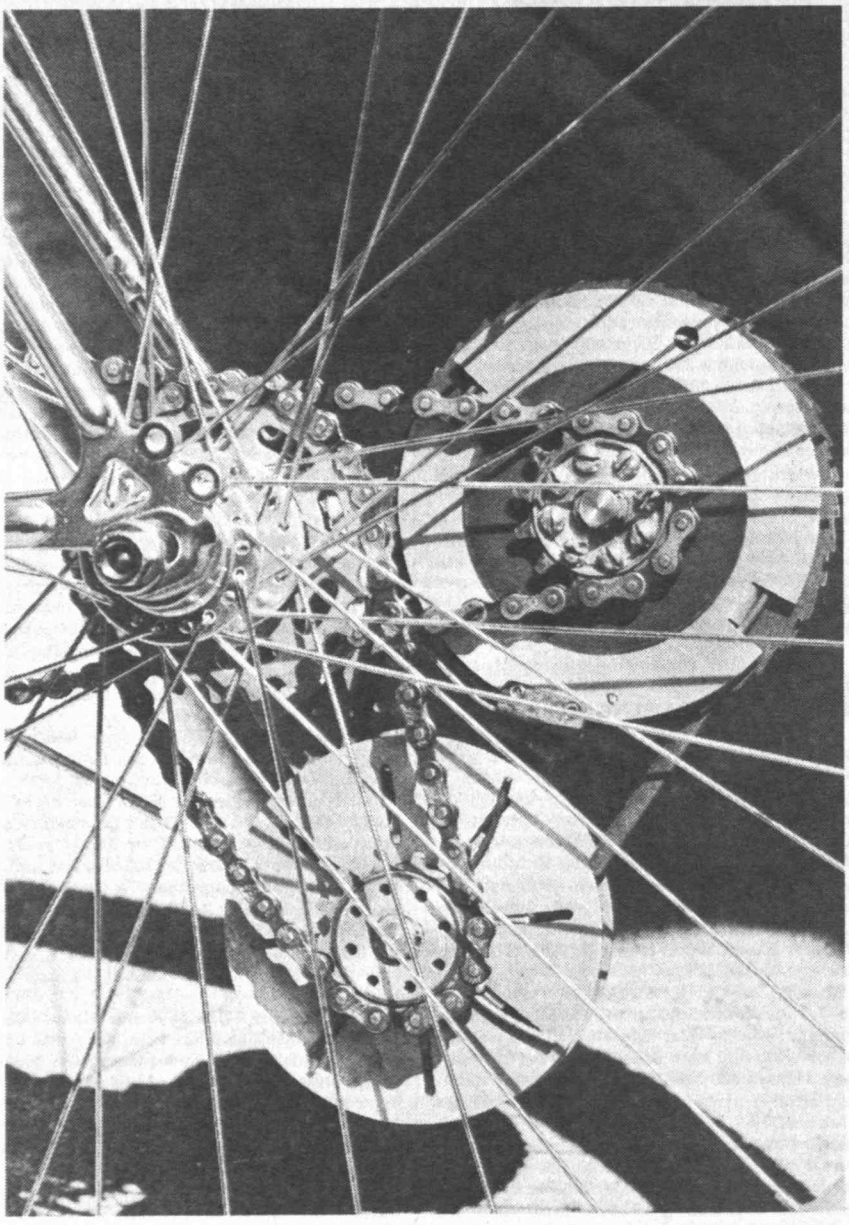
Peter W. Huber, Ph.D.'76, senior fellow of the Manhattan Institute, is the author of *Liability: The Legal Revolution and Its Consequences* (New York: Basic Books, 1988). Huber, who holds a law degree from Harvard, argues that while tort law is out of control "we can reconcile the generous impulses of an affluent society with time-tested legal instruments. . . ."

The key to restoring U.S. competitiveness is to increase the nation's savings rate, say **George N. Hatsopoulos,** Sc.D.'56, and two co-authors in the July 15 issue of *Science.* "A sharp rise in U.S. savings," they argue, "is the sine qua non of any effort to maintain U.S. relative standing in the world economy." Hatsopoulos' co-authors are economists **Paul R. Krugman,** Ph.D.'77, of M.I.T. and **Lawrence H. Summers,** '75, of Harvard.

The deaths of **Cornelius J. M. Den Dulk,** S.M.'62, of Enschede, the Netherlands, on September 18, 1987, and of Colonel **Horace A. Quinn,** S.M.'34, of Provo, Utah, on March 17, 1983, have been reported; further details are not available.

III MATERIALS SCIENCE AND ENGINEERING

Klaus M. Zwilsky, Sc.D.'59, was installed as vice-president of the American Society for Metals International at the World Materials Congress in Chicago in September; he'll be president in 1989-90. Zwilsky is staff director of the National



This chain-side view of the automatic bicycle transmission invented by James B. Reswick, Sc.D.'54, illustrates this highly simplified description of how it works: Two special pulleys (bottom and top right) that can change their diameters are connected by a V-belt. These variable-diameter pulleys are made of seven arms that pivot in or out. When all the way in they nest to form what amount to solid V-belt pulleys. When out as far as they can go, they form pulleys that have about twice the diameter. The "drive" pulley (top) "measures" the rider's force on the pedals, and when this force exceeds a pre-set value it automatically reduces its diameter in proportion to the force. The other pulley arms are pulled to expand so the belt stays tight. It's this feature, writes Reswick, that "makes a smooth belt drive practical for a bicycle, perhaps for the first time in bicycle history."

Would You Like That Bike With Manual Transmission or "Automatic?"

It may be an elegant solution to the problem, but the traditional derailleur is a finicky and unsatisfactory way for riders of 10-speed chain-driven bicycles to shift gears, says James B. Reswick, Sc.D.'54.

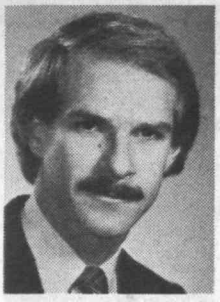
Reswick has a better answer—what he believes is the first continuously variable automatic transmission in the 100-year history of chain-drive bicycles.

"In the world of machines that employ speed-change transmissions," writes Reswick in a report of his patented invention for *Human Power* magazine, "the bicycle is almost unique. Most machines transmit power from high speed and low torque to low speed and high torque," he explains. "The bicycle is just the reverse." The result is that a bicycle transmission has to be very robust, able to withstand a torque equal to or greater than that produced by the rider's weight.

Reswick's invention meets these goals, and it was inspired by his work on a somewhat similar and novel automatic transmission for an electric wheelchair. (He is director of the National Institute on Disability and Rehabilitation Research, the field in which he's been working since he left M.I.T. in 1959).

When it comes to riding, Reswick's 26-inch Miyata commuter bicycle with his "Ride-a-Matic" transmission can have its moments. "When starting on the level," says Reswick, "I push rather hard, as do most riders, to accelerate. This causes the pedals to rotate about a half turn without motion of the bike as the unit shifts quickly down to low gear. Acceleration is then rapid and smooth, with a noticeable reduction in pedal pressure and only a moderate increase in cadence" until the unit reaches "high" gear at about 10 mph. A second sudden acceleration sets the same cycle into operation once more: "My cadence increases suddenly, then gradually the bike accelerates as the pedal force decreases and the drive returns to 'high' gear." □

PHOTO: JAMES RESWICK



T.A. Schwartz

Materials Advisory Board, National Academy of Sciences. . . . **W. David Kingery,** Sc.D.'50, has retired to the rank of professor emeritus at M.I.T. after 41 years of full-time teaching and research. In 1958 Kingery won the first John Jeppson Medal of the American Ceramic Society, and he was made an honorary life member of ACS in 1983. His specialty is ceramic technology, in particular ceramic fabrication processes. He is credited with developing the field of physical ceramics and with organizing at M.I.T. the nation's first educational program in that field.

From Highland Park, N.J., **Richard E. Riman,** Ph.D.'87, writes, "Since graduation I have been an assistant professor at Rutgers University. My research interests include powder processing science and ceramic materials synthesis." Riman recently married Barbara Sorrentino. . . . And from Mexico City **Juan Sodi Y De La Tijera,** Ph.D.'69, sent the Alumni Fund a gift in Belize dollars "which you can easily change at a U.S. bank" and a note that he heads "a group of companies in chemical products and feedstuffs."

Bernhardt J. Wuensch, Ph.D.'63, TDK Professor of Materials Science and Engineering at M.I.T., is now director of the Institute's Center for Materials Science and Engineering. It's an interdepartmental research unit with major programs in superconductivity, flow and fracture in high-temperature alloys, deformation and fracture in polymers, properties of microcrystalline and glassy metallic alloys, platinum surfaces and catalysts, optical materials, amorphous semiconductors, and phase transitions. Wuensch, an expert in ceramics and crystallography, succeeds Professor **J. David Litster,** Ph.D.'65, now director of the Francis Bitter National Magnet Laboratory at the Institute.

Thomas A. Schwartz, S.M.'77, of Simpson Gumpertz and Heger, Cambridge, is chairman of the American Society for Testing and Materials new subcommittee on the Performance of Exterior Building Wall Systems. Schwartz explains that, though they incorporate well-designed components, "many walls perform miserably because designers and builders fail to integrate components properly." The committee's assignment is to develop "standards of system performance as opposed to product performance," he says.

Gordon E. Forward, Sc.D.'66, has added a new job with Texas Industries, Inc.: he's now president of the Cement/Concrete Division in Dallas as well as president and CEO of the Chaparral Steel Co., a Texas Industries subsidiary in Midlothian, Texas. . . . **George Freedman,** '43, is the author of *The Pursuit of Innovation: Managing the People and Processes That Turn New Ideas into Profits,* published by the American Management Association early last summer. Freedman, formerly director of Raytheon's New Products Center, is now a consultant on organizing and implementing innovation based in Wayland, Mass.

The death on August 13, 1987, of **Milton S. Tarnopol,** S.M.'36, at his retirement home in Berkeley, Calif., has been reported to the Alumni Association. Tarnopol studied ceramics at M.I.T. and later at Pennsylvania State University, was a member of the research staff at Batelle Memorial Institute, and then served for 33 years in the Glass Research Laboratory of Pittsburgh Plate Glass Co. (now PPG Industries), Pittsburgh. Tarnapol's research led to 28 patents, including one for defrosting rear windows in automobiles.

IV ARCHITECTURE

Calling attention to the 25th anniversary of his firm, **Bernard Rothzeid,** M.Arch.'54, writes from New York: "After a two-year Fulbright in Rome, I spent seven years with I.M. Pei and Partners before setting up Rothzeid Kaiserman Thomson and Bee in 1963. The firm's work includes housing, health facilities, theaters, and educational and commercial work. We've won numerous awards, including a national prize from the AIA. Meanwhile, I've been on the board of the Methodist Hospital of Brooklyn for many years and was recently honored by my other alma mater, Cooper Union, with its highest award for architecture, the Augustus Saint Gaudens Medal."

Two members of the department faculty at M.I.T. have retired to the rank of professor emeritus: **Richard Filipowski** and **Waclaw Zalewski.** A native of Poland, Filipowski came to M.I.T. in 1952 to teach a new course in form and design, and he's been here ever since—while developing a national reputation as a modern sculptor. Also Polish by birth and education, Zalewski had major engineering experience in Venezuela before coming to the department in 1966 to teach structural design. Since then he has done pioneering work in the design of shell and prefabricated structures that have been acclaimed for their "ingenuity and purity of form."

Nancy L. Goodwin, M.Arch.'74, has been promoted to principal at Notter Finegold & Alexander, Inc., Boston. She joined the firm in 1977 and became an associate in 1981. Renovation of Harvard's Radcliffe Quadrangle dormitories was a recent major (four-year) project for which she was manager. . . . **Gerald W. Billes,** M.A.A.'72, announces that his firm, Billes/Manning Architects, New Orleans, has been selected architect/engineer for major improvements and expansion of the New Orleans International Airport; estimated cost: $18 million. . . . **Peter Blewett,** M.A.A.'77, has been advanced to senior associate at The Stubbins Associates, Inc., Cambridge; **Bruce H. Creager,** M.Arch.'68, is now an associate partner at Hoskins Scott Taylor and Partners, Inc., Boston; and **William L. Demiene,** M.Arch.'57, is now a vice-president of Albert Kahn Associates, Inc., Detroit, where he is also chief architectural designer.

From **Alva Tabor III,** M.Arch.'77, in San Francisco: "I joined Bechtel's building design construction group over a year ago. Active in diverse array of projects in Bechtel's broadening scope of work: Disney park in Orlando, hotel in Andros, Bahamas. Now involved in DoS and DoD work. Married nine years, two daughters." . . . **Bruce Joffe,** M.A.A.'78, writes that he is manager of automated mapping projects at BSI Consultants. Living in Piedmont, Calif., he and his wife Karen have two daughters in middle school and are "still living at the high-energy intensity level so familiar at the 'Tute."

Masaaki Sakuta, '60, is vice-dean of the College of Science and Technology at Nihon University, Tokyo, and is looking forward to cooperative work with M.I.T. under the Institute's Nichidai Fund.

From Los Angeles, **John Dale,** S.M.'86, writes that he has been with Barton Myers Associates since July 1986 and was made an associate of the firm in September 1987. He was co-author of "Sunday Architecture" in *Space and Security* magazine for December 1986. . . . **Jonathan S. Linowes,** S.M.'86, is a general partner at Sirlin Computer Corp., Hudson, N.H., specializing in database and computer graphics software development, consulting, and training. ("Inquiries invited," he writes.)

Three alumni report major architectural commissions: **Ernest E. Kirwan,** M.Arch.'59, partner



N. Goodwin



D. Georgopulos

at Keyes Associates, Waltham, Mass., was principal-in-charge for the first two biotech research and development buildings (80,000 square feet) at the Massachusetts Biotechnology Research Park, Worcester; **John B. Davidson,** M.Arch.'71, of Davidson Yuen Partners, Vancouver, was architect for Pacific Place, a 200-acre urban development in Vancouver that he describes as "the largest project of this type in North America"; and **Lawrence Kasser,** M.Arch.'73, of Bellows Falls, Vt., has been saluted by *Restaurant and Hotel Design* magazine for his design of the Equinox Spa, Manchester, Vt.

The new president of the 75-year-old Women's City Club of Boston is **Diane Georgopulos,** M.Arch.'82. Georgopulos lives in Brookline and works as an architect for the Massachusetts Housing Finance Agency, Boston. . . . Summer exhibitions, now closed—alas—before we could call them to readers' attention: paintings of **Todd Silver,** Ph.D.'86, were at City Place, Boston, part of a show by the Massachusetts Artists Fellowship. . . . "Street Poems," an unconventional display converting streets noises into visual images conceived and designed by **Sara Geitz,** S.M.'85, was installed in front of the Hartford Arts Center. . . . And a large inflatable sculpture called "In a Lamprey's Mouth" by **Jon Goldman,** S.M.'85, was also part of the Hartford center's summer "Fusion/Fission" program of innovative projects.

V CHEMISTRY

Academic honors: Professor **Daniel S. Kemp** won the 1988 M.I.T. Science Council's prize for excellence in undergraduate teaching, honored especially for his teaching of 5.11—Principles of Chemical Science. . . . **Donald M. Smyth,** Ph.D.'54, is now Paul B. Reinhold Professor at Lehigh, where he has taught since 1971. . . . And **David Ledlie,** Ph.D.'66, at Bates College (Lewiston, Maine) since 1977, is now associate professor and chair of the Department of Chemistry.

To **Philip A. Selwyn,** Ph.D.'70, a 1988 Presidential Rank Award to recognize excellence in the federal Senior Executive Service; Selwyn is director of the Office of Naval Technology—the senior civilian manager of a $430-million-per-year program to assay for the navy and marine corps the military worth of emerging technologies. . . . From the Chemistry Department at the University of Pittsburgh, **Kenneth D. Jordan,** Ph.D.'74, reports two current professional activities: he is a member of the Joint Pittsburgh and Illinois Supercomputing Centers Peer Review Board, and he is vice-chairman-elect of the Theoretical Chemistry Subdivision, Physical Chemical Division, American Chemical Society.

We record with regret the deaths of three alumni: **Arnold H. Nevis,** Ph.D.'56, of Gainesville, Fla.; and **Alfred Stockfleth,** Ph.D.'42, and **Gordon T. Vaala,** Ph.D.'36, both of Wilmington, Del. Nevis was a long-time member of the Department of Physics and Electrical Engineering at the University of Florida; he died on July 4, 1986. Stockfleth was a 36-year employee of the Du Pont

Cryogenics Pioneer Acknowledges a Debt

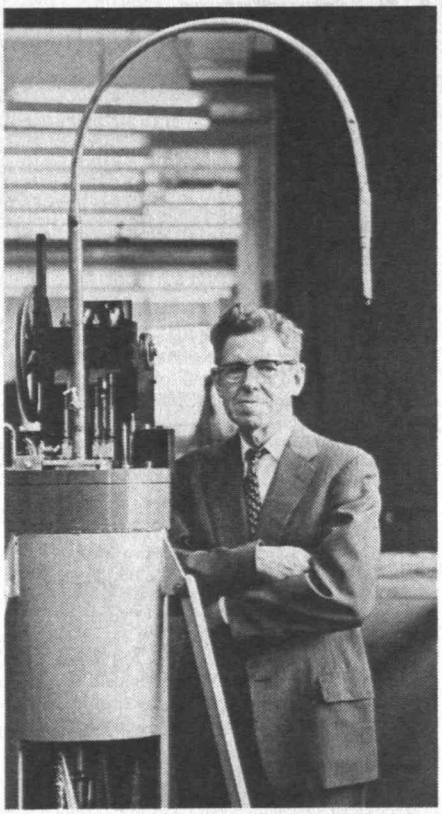


When Howard O. McMahon, Ph.D.'41, began graduate work in the Chemistry Department, a young instructor named Samuel C. Collins was just beginning to develop his specialty of low-temperature technology. By the time McMahon left M.I.T., he, too, was hooked: he was fast developing a specialty in cryogenics—the technology of extremely low temperatures.

In 1943, McMahon took his expertise with him to a new job at Arthur D. Little, Inc., (ADL).

Three years later, Collins—who had in the meantime switched from chemistry to mechanical engineering—made his breakthrough: a "cryostat" to turn helium gas into liquid helium, which remains even today the most effective super-cold refrigerant known.

Collins' machine was far simpler and more efficient than anything previously available. He took it to his friend McMahon at ADL, where it was marketed as the ADL-Collins Helium Cryostat beginning in 1948. A quick success, the machines were in use for research and as super-cold refrigerators in 200 academic and industrial laboratories worldwide by 1961.



M.I.T.'s ground-breaking role in low-temperature technology was commemorated in 1963 when the late Professor Samuel C. Collins (left) was invited to send his helium cryostat to the Smithsonian. Now it's commemorated again with the establishment of the Howard O. McMahon research endowment for physical chemistry. McMahon (far left) credits Collins with inspiring some of his own contributions to cryogenics, which have been successfully commercialized by Helix Technology Corp., sponsor of the fund.

Meanwhile, McMahon had made some important cryogenic inventions of his own before becoming head of ADL's Research and Development Division, then executive vice-president, and in 1964 president. Despite his growing responsibilities, McMahon's interest in cryogenics never faltered. He was instrumental in establishing ADL's super-cold-temperatures subsidiary, ultimately known as Helix Technology Corp., and he watched his own cryogenic inventions grow to generate more than 70 percent of Helix's revenues.

Why tell this story now?

Because McMahon and Helix have expressed their thanks to M.I.T. for its role in their cryogenics successes with the establishment last summer of the Howard O. McMahon Fund. Income from the fund will be used for physical chemistry at the Institute—"seed" research support, fellowships, new equipment, or whatever is needed most. □

Co., working first as a research chemist and later in the Plastics Department where he invented several plastics processing techniques; he retired in 1978 and died in July 1988. Also a long-time (36 years) employee at Du Pont, Vaala died on November 18, 1987; he held several research and executive positions before retiring in 1972.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

News from five alumni in the world of business:

□ **Ronald H. Cordover,** Ph.D.'67, continues as president of Science Applications, Inc., Wayne, N.J., while also taking the helm as chairman of Berkline Corp., Morristown, Tenn., of which he has been a director. (Berkline is owned in part by Cober B. Corp., of which Cordover is co-owner.)

□ **Einar Greve,** S.M.'53, is now chairman as well as president and CEO of the Tucson Electric Power Co.

□ **Roger W. Kapp,** '58, formerly a partner at Donovan Leisure Newton and Irvine, New York City, is now senior vice-president and general counsel for American Home Products Corp., also in New York.

□ **John R. Samson, Jr.,** E.E.'73, is a principal engineering fellow at the Space and Strategic Avionics Division of Honeywell, Inc., Clearwater, Fla.; at the end of last year he was honored with a Honeywell Technical Award for a space applications distributed processing system.

□ **John S. Wurts,** '70, has moved from Management Decision Systems, Inc., Waltham, Mass., where he was president, to be chairman and CEO of Symbolics, Inc., Cambridge.

A $16,000 Newport Award from the Optical Society of America came to **Robert W. Schoenlein,** E.E.'87, at M.I.T. this spring. The award program, funded by Newport Corp., honors graduate students for doctoral research that will "advance laser and electro-optics technology"; Schoenlein's work is on femtosecond electronic processes in metals and semiconductors. . . . To Professor **Arthur L. Pike,** E.E.'54, Tufts University's 1988 Lillian and Joseph Leibner Award for distinguished teaching and advising.

Two members of the M.I.T. faculty were honored as they reached the milestone of retirement last spring: **Thomas H. Lee,** Philip Sporn Professor of Energy Processing, and **Joseph Weizenbaum,** professor of computer science and engineering. Lee had a distinguished career at the General Electric Co. before coming to the Institute in 1960 to pursue interests in technology assessment and energy policy; he was on leave

PHOTO: TED POLUMBAUM FROM THE M.I.T. MUSEUM



T.H. Lee

from 1984 to 1987 to direct the International Institute for Applied Systems Analysis near Vienna. At M.I.T. since 1964, Weizenbaum is widely known for his unconventional views about computers and artificial intelligence. . . . **Frank Barnes,** E.E.'51, retired from the Charles Stark Draper Laboratory during the summer; he worked for 13 years at Draper in electro-optical design.

Richard Neubauer, S.M.'71, a marketing expert at Johnson Controls, Inc., is co-author of *The Intelligent Building Sourcebook* (Prentice Hall, 1988). The book reviews systems currently available for integrating telecommunications with office and building automation, and for automating security and building maintenance functions. . . . Professor **Ernest Shiu-Jen Kuh,** Ph.D.'52, of the University of California at Berkeley is one of eight candidates for four places on the American Association for the Advancement of Science's Committee on Nominations. If elected, he'll begin a two-year term early in January.

From New York, **Jerome D. Abernathy,** Ph.D.'87, writes, "Working on automated trading strategies at Morgan Stanley and Co. I work closely with **Eugene Flood,** Ph.D.'81 (XIV)." And from **Kenneth Y. Yun,** S.M.'85, "Working for TRW since graduation. Live in Hermosa Beach, Calif., with wife and 9-month-old son, Paul." . . . **Bonnie Dorr,** S.M.'87, who works in artificial intelligence at Mitre Corp., Burlington, Mass., was married in July to a Mitre Corp. colleague, Bruce Dawson.

The death of Rear Admiral **Thomas J. Rudden, Jr.** (U.S.N. Ret.), S.M.'46, on March 10, 1986, was reported to the Alumni Association this summer. Rudden served in the South Pacific during World War II, was a destroyer commander during the Korean War and a flotilla commander in Vietnam. He commanded a destroyer that participated in the sea recovery of Mercury astronauts in the early 1960s. After retiring from the navy, he was a consultant for Emerson Electric Co. and a director of McLaughlin Research Corp. . . . **Mark A. Princi,** '36, of Marblehead, Mass., an electrical engineer with General Electric Co. for 37 years, died on May 14, 1988. He had been chairman of the Marblehead Municipal Light Commission for six years and was an officer of the Corinthian Yacht Club. . . . Word of the death on June 30, 1984, of **Charles G. Seifert, Jr.,** '39, in Hacienda Edode, Mexico, has reached the Alumni Association; details are not known.

VI-A INTERNSHIP PROGRAM

The "three-H days of summer" (hazy, hot, and humid)—that's how we'll remember August 1988 in New England as this is being written. Twenty-four days of 90+ degree temperatures and a dew point of 77 degrees both were Boston records. It was even more comfortable in Dallas when **Cecil H. Green,** S.M.'24, hosted his 15th annual luncheon for VI-A students and Texas Instruments management on July 21. Director **Kevin J. O'Toole,** N.E.'57, and I attended at the newly relocated Petroleum Club in downtown Dallas. I presented Cecil with two mounted photographs showing the buildings where he did his VI-A graduate work at GE in Schenectady; one, which I was lucky enough to obtain from GE's archives, was actually taken circa 1923, when he was there.

As of July 1, **William E. Weihl,** Ph.D.'84, has been promoted to associate professor at M.I.T. He did his VI-A work at IBM's Watson Laboratories, Yorktown Heights, N.Y.

A few of you learned during June that **Lydia O. Wereminski** had won the prestigious James N. Murphy Award at the Honors Convocation in May and called with congratulations. One of the callers was **John D. Chisholm,** S.M.'76, who was back East for Harvard and M.I.T. alumni reunion activities.

The following VI-A'ers were among the several alumni I had the pleasure of meeting on Technology Day, June 3: **Michael J. Marcus,** Sc.D.'72, of Washington, D.C.; **William E. Northfield,** S.M.'57, of Osterville, Mass.; **Stephen Swerling,** '63, founding partner of Mentor Graphics, Portland, Ore.; and **Raymond S. Stata,** S.M.'57, president of Analog Devices, who was completing his year as president of the Alumni Association. (Stata's son **Raymie,** '90, is on his first VI-A assignment with Hewlett Packard in Palo Alto.)

In Cambridge for a conference, **Eric D. Black,** S.M.'81, arranged to have lunch and brought me up to date. He told of his unique marriage ceremonies, part of which took place on board a sightseeing ship with the captain officiating under the Golden Gate Bridge in San Francisco Bay. Eric is a senior software engineer with Atherton Technology, Sunnyvale, Calif.

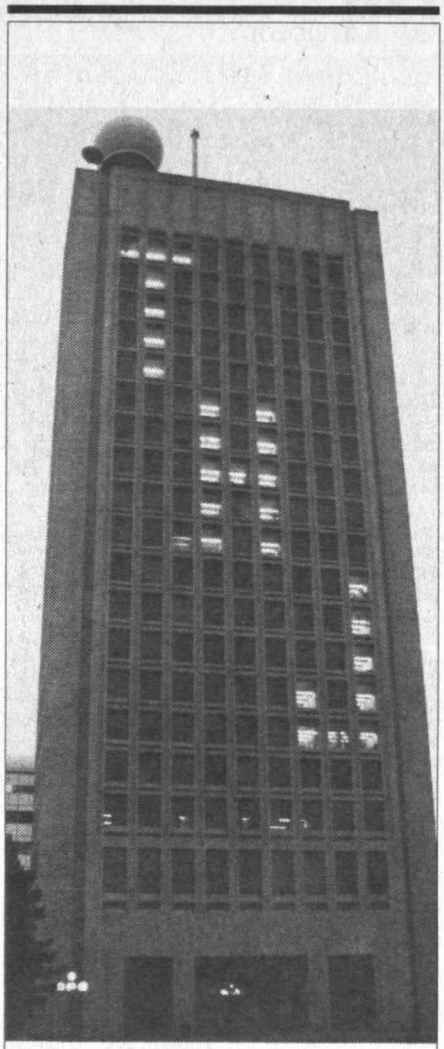
John V. Burroughs, '82, came in for a visit; he's working for Data General in Westboro, Mass. . . . **William J. Butera,** '82, was back from Germany to turn in his master's thesis at the Media Lab and stopped in for a pleasant visit; he plans to remain in Germany and to marry a German girl. . . . Attending the Special Summer Program on "Structure and Interpretation of Computer Programs" given by this department was **Thomas H. Crystal,** Sc.D.'66, and we had several chats during his week-long stay. Tom's son, **Michael R.,** S.M.'87, is also a VI-A graduate. . . . Another visitor was **Denice D. Denton,** Ph.D.'87, who is now assistant professor of electrical engineering at the University of Wisconsin, Madison.

Vincent W. S. Chan, Ph.D.'74, has been promoted to assistant division head, Division 6 (Communications), at M.I.T.'s Lincoln Laboratory. . . . A wedding invitation arrived from **Imre Gaal, Jr.,** S.M.'86, for his marriage on June 25 in Orange, Calif. Imre has been studying toward his M.D. at Dartmouth since graduating from M.I.T. . . . A letter from **James A. Lutz,** S.M.'85, to update our records gives his new home as Campbell, Calif., and his work as product manager at Micrognosis, a subsidiary of Control Data Corp.

In mid-June Kevin O'Toole and I had a surprise visit from a **John Longley,** S.M.'34. Fortunately, Professor Emeritus **Truman S. Gray,** Sc.D.'30, whom Mr. Longley knew, was in that day, so a wonderful reminiscence ensued. Longley mentioned that his World War II office in the Pentagon was close to that of Professor Emeritus **Edward L. Bowles,** S.M.'22, with whom I had an interesting conversation recently. . . . Unfortunately, I missed a visit from **David L. Lyon,** Ph.D.'72, here from the West Coast. Dave is president of a new company called Pacific Communications Sciences, Inc., in San Diego; he was on VI-A when I first became director in 1969.

Back on campus for a visit was **Edward W. Maby,** Ph.D.'79; Ed is on the electrical engineering faculty at Rensselaer. . . . **Robert B. Parente,** Ph.D.'66, of Los Angeles stopped in the day before Technology Day, having just returned from England. He was consulting there for the electric power industry, which is being denationalized by the Thatcher government. . . . **Mark W. Reichelt,** S.M.'87, a Ph.D. candidate at M.I.T., came by one afternoon to tell me of his marriage on August 20; his wife is a graduate student in the M.I.T. School of Management.

The Bent of Tau Beta Pi carries the announcement of the marriage of **William M. Shyu,** S.M.'86, to **Chinny Yue,** '87 (II).



It isn't every new department head who has his initials displayed building-size on the day he takes office. But it happened last July 1 to Professor Thomas H. Jordan—his students' way of showing their enthusiasm as he became head of the Department of Earth, Atmospheric and Planetary Sciences.

Daniel M. Sable, Sc.D.'73, was on campus for a symposium run by Professors **John G. Kassakian,** Sc.D.'73, and **Martin Schlecht,** Sc.D.'82, in mid-May and stopped for a visit. Dan, who was at RCA/Hightstown, N.J., is currently involved in research at Virginia Polytechnic Institute, Blacksburg.

Others, not listed above, who signed our VI-A guest book since last writing are **Steven K. Ladd,** S.M.'81, with Raychem Corp., San Jose; **David G. Lau,** S.M.'86, of Newton, Mass.; **William T. Mayweather,** S.M.'87, of Lawrenceville, N.J.; **Anne E. Moroney,** '84, with National Semiconductor, Santa Clara, Calif.; and **Raymond A. Schnitzler,** S.M.'86, with Bellcore in Red Bank, N.J.

I hear from many people who tell me they read these "VI-A Notes" religiously. I missed the last issue but will do my best to keep up and urge any of you who have information of interest about your lives or those of other VI-A'ers to call or write.—John A. Tucker, Special Assistant to Department Head, for VI-A, Room 38-473, M.I.T., Cambridge, MA 02139-3931

PHOTO: JOHN GOFF

VII BIOLOGY

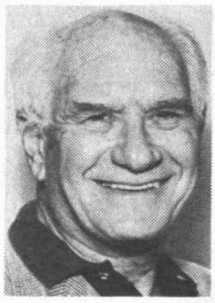
A signal honor for **Allan Spradling,** Ph.D.'75, of the Department of Embryology at the Carnegie Institution of Washington: he has been named a Howard Hughes Medical Institute investigator. Under the appointment, Spradling will become a Hughes employee but will retain his appointment at Carnegie—and also one at Johns Hopkins, where he teaches. Spradling's research is on the molecular basis of gene amplification and other fundamental processes occurring during oogenesis.

Two changes have been announced by the department at M.I.T.:

□ **John M. Buchanan,** who has been professor of biochemistry since 1953 (holding the John and Dorothy Wilson Professorship since 1967), has retired with the title professor emeritus; he'll continue part-time teaching and research. Buchanan studied at De Pauw, Michigan, and Harvard, and taught at the University of Pennsylvania before coming to M.I.T. He has worked on a variety of problems in human biochemistry and nutrition and was for many years chairman of the committee for M.I.T.'s Course XXV, the interdisciplinary science program.

□ **Helmut Zarbl** has been designated Robert A. Swanson ('69) Assistant Professor, occupying a chair endowed by the cofounder and CEO of Genentech, Inc. Zarbl came to M.I.T. in 1987 at the invitation of the Department of Applied Biological Sciences; his research is on oncogenes and their role in chemical carcinogenesis.

A confession from Nobel laureate Professor **Susumu Tonegawa** of M.I.T. to the *Boston Herald* as the baseball season opened last spring: "It's a little bit distracting for me. It's hard not to turn the TV on or go to the games."



D. Frisch



M.W.P. Strandberg

VIII PHYSICS

Three long-time members of the M.I.T. faculty in physics have retired with the title professor emeritus: **David H. Frisch,** Ph.D.'47, **Stanislaw Olbert,** Ph.D.'53, and **Malcolm W.P. Strandberg,** Ph.D'48.

Frisch interrupted his graduate study at the University of Wisconsin in 1942 to work at Los Alamos on the atomic bomb project; when he went back to school in 1945 it was at M.I.T., where he joined the faculty in 1948 and became professor in 1958. On leave, Frisch studied with Niels Bohr in Copenhagen in 1954, worked at CERN, Geneva, in 1960, and taught at the University of Washington in 1966. In addition to important contributions to nuclear and elementary-particle physics, Frisch has worked intensively for nuclear disarmament and on other policy issues central to the physics community.

Olbert joined the M.I.T. research staff upon completing his doctorate, and he has been a member of the faculty since 1957 in the field of theoretical astrophysics and cosmic ray physics.

On the Institute staff for 46 years, Strandberg is a specialist in microwave physics and technology —fields in which he first worked at the M.I.T. Radiation Laboratory. He was the author of a classic text, *Microwave Spectroscopy,* in 1954; has been active in several programs of the American Institute of Physics; and has taught at institutions in England, France, Italy, and Switzerland as well as at M.I.T., where he headed the Research Laboratory of Electronics' group in microwave spectroscopy.

Robert N. Noyce, Ph.D.'53, who achieved fame as founder of Intel Corp., of which he is vice-chairman, is now CEO of a new start-up, Sematech, in Austin, Tex.; it's a consortium of semiconductor manufacturers. Meanwhile, **Albert D. Wheelon,** Ph.D.'52, has retired from his post as chairman and CEO of Hughes Aircraft Corp. in Los Angeles. . . . **Thomas D. Halket,** S.M.'71, partner in Scheffler Karlinsky and Stein, New York, is now chairman of the American Bar Association's Section of Science and Technology, responsible for recommending ABA policy in those fields. Halket studied law at Columbia (J.D.'74). . . . **E. Michael Riordan,** Ph.D.'68, who's now affiliated with the Stanford Linear Accelerator Center, is the author of *The Hunting of the Quark; A True Story of Modern Physics* (Simon and Schuster, Inc., 1988). "The 1970s were heady times for high-energy physics," writes Riordan. "Nothing quite like these quarks had ever been encountered before." . . . Two books by **Thomas McDonough,** '66, were included by *Library Journal* in its "Best Sci-Tech Books" list for 1987—*The Search for Extraterrestrial Intelligence* (now in paperback) and *Space: The Next 25 Years.* . . . **Steve Fetter,** '81, assistant professor in the School of Public Affairs, University of Maryland, is the author of *Toward a Comprehensive Test Ban* (Ballinger, 1988), which the publisher describes as "the first book to examine all of the key issues in today's test ban debate." Fetter completed the book while a research fellow in Harvard's Kennedy School of Government.

Frederick L. Scarf, Ph.D.'55, chief scientist for space research and technology at TRW, Redondo Beach, Calif., died in Moscow on July 17. He collapsed suddenly on July 12 while attending an international space meeting, apparently the victim of a brain tumor. Scarf was widely regarded as the world's leading expert on interplanetary plasma waves, and he was in Moscow to consult on Soviet space missions—an activity in which he had been involved for more than a decade. Scarf had been a lead scientist on the twin missions to the Martian moon Phobos launched last July, and he expected to play a similar role in the Soviets' ambitious plans for exploring Mars itself during the years ahead.

IX BRAIN AND COGNITIVE SCIENCES

Only two items this month: **Foteos Macrides,** Ph.D.'70, principal scientist at the Worcester Foundation for Experimental Biology, has been selected for a Javits Award from the National Institute of Neurological and Communicative Disorders and Stroke. Macrides will receive $1.9 million over seven years to support his research on the interrelationship of social influences and hormones in producing and altering emotions. Macrides has been a member of Worcester's Neurobiology Group since 1972. . . . At M.I.T., Professor **Tomaso A. Poggio** has been named to the Uncas and Helen Whitaker Professorship. His research is in the field of computational neuroscience, including computer vision and human vision and motor control, and he is co-director of M.I.T.'s Center for Biological Information Processing.

X CHEMICAL ENGINEERING

One of the nation's major honors came to **Paul M. Cook,** '47, on July 15 at the White House—the National Medal of Technology. Cook is founding chairman and CEO of Raychem Corp., Menlo Park, Calif.; he was cited for "his vision and entrepreneurial efforts, his technical accomplishments, and his business and technical leadership. They made him a "key contributor in creating a worldwide chemically based industry," said the White House citation.

John P. Longwell, Sc.'43, who had a distinguished 32-year career at Esso Research and Engineering Co. before joining the M.I.T. faculty in 1976, is now professor emeritus, having retired during the summer. Longwell has been responsible for teaching and research in the fields of energy and combustion in the department and in the M.I.T. Energy Laboratory, and he was honored as M.I.T.'s first Edwin R. Gilliland Professor in 1981.

The Wall Street Journal reports that retirement has also come to **Joseph Byrne,** Sc.D.'50, formerly corporate vice-president for human resources at Unocal Corp., Los Angeles.

Roy N. Levitch, Sc.D.'66, reports from Houston that he and his wife Janine (who was formerly a "techretary" in the Chemical Engineering Department) made "a long-awaited visit to the Institute last April for a first look at the 'new' chemical engineering building and to visit old friends on the faculty." The Levitchs' three teen-aged boys stayed home. Levitch is in corporate planning at Shell Oil Co. . . . As this is written, the department is looking forward to similar visits by many alumni for the centennial of chemical engineering at M.I.T. in October; a full report will appear in this space in January.

Robert W. Davis, S.M.'50, president and CEO of Chevron Chemical Corp., has been made a vice-president of the parent Chevron Corp. . . . **Robert N. Gurnitz,** Ph.D.'66, has moved from Bethlehem Steel Corp. to Webcraft Technologies, Inc., North Brunswick, N.J., where he is president and CEO. . . . **Otha C. Roddey,** S.M.'51, who retired early this year as president of Parsons Corp., Pasadena, of which he continues as a director, has been elected a director of Gibraltar Financial Corp., Beverly Hills.

Robert V. Bruce, '44, made a career change when he returned from World War II: instead of finishing his degree in Course X at M.I.T., he ultimately earned a Ph.D. in history from Boston University, where he's now a member of the faculty. Bruce was in the news during the summer when his new book, *The Launching of Modern American Science, 1846-1876,* was chosen for a Pulitzer Prize.

We record with regret the deaths of two alumni:

□ **James E. Evans,** Sc.D.'38, who retired in 1975 from Du Pont's Atomic Energy Division, died while on vacation in Florida on February 20, 1988. Evans "always cherished many happy memories of good times at M.I.T.," wrote his wife, Retta Lou Gelling Evans, from their home in Moylan, Pa.

□ **William G. Hockberger,** S.M.'37, of Summit, N.J., died on July 15. Hockberger joined Esso, the predecessor company to Exxon, in Baton Rouge, La., upon graduating, and he retired in 1974 from Exxon's Linden, N.J., facility; thereafter he worked for five years in technical information with the American Petroleum Institute.

Further details have now arrived on the professional careers of three alumni whose deaths were reported in the October issue.

Ralph M. Gifford, S.M.'58, who died on April 4 in New York, joined Pfizer, Inc., in New York as development engineer upon leaving M.I.T. He moved to Groton in 1979 to be general production manager for Pfizer's Chemical Division and at the time of his death was the company's director of chemical regulatory affairs.

Edwin L. Howard, S.M.'38, who died in Davis, Calif., on March 19, worked for 39 years with Caltex Petroleum Co., retiring in 1977 after filling posts in the Persian Gulf, France, and New York City; the Howards had been 26-year residents of Rye, N.Y., before moving to their retirement home in Winters, Calif.

Richard N. Palmer, S.M.'32, had been a resident of the Wolfeboro, N.H., area since completing studies at M.I.T. Palmer worked on atomic-bomb research at M.I.T. during World War II and thereafter was self-employed in chemical research.



L. Rodwin

XI URBAN STUDIES AND PLANNING

McGraw Hill Book Co. has announced publication of *Construction Productivity: On-Site Measurement and Management* by **Louis E. Alfeld,** M.C.P.'68. Alfeld is a founder of Decision Dynamics, Inc., a consulting firm specializing in applying human performance engineering to construction needs. He teaches in the construction management program of the School of Engineering at Washington University, St. Louis, and is a practicing attorney. The book is described as a summary of methods developed by Alfeld for using computer-based analyses, including spreadsheets, to measure performance at construction sites.

Two distinguished members of the department at M.I.T.—Professors **Aaron Fleisher,** Sc.D.'50, and a **Lloyd Rodwin**—have retired to the rank of professor emeritus; together they represent just under 70 years of service to the field and to the M.I.T. department. . . . Fleisher came to the Institute as a research associate in meteorology in 1950, transferring to what was then called the Department of City and Regional Planning in 1960. Since then Fleisher has brought the quantitative rigors instilled by a graduate education in meteorology to a wide range of studies of urban infrastructure and economics. . . . At M.I.T. since 1946, when he was made a research associate while completing his Harvard Ph.D. (1949), Rodwin has been a prolific author and outstanding teacher on problems of land use, housing, urban planning, and regional development especially in developing countries. He was head of the department from 1970 to 1974 and since then has been Ford International Professor.

Daniel Greenbaum, M.C.P.'75, has a new—and sensitive—job: he is commissioner of the Massachusetts Department of Environmental Quality Engineering, the watchdog and chief protector of the state's environment. Associated for 9 years with the Massachusetts Audubon Society, Greenbaum is the first DEQE commissioner with an environmental activist background, and environmentalists expect big things of him. As commissioner, Greenbaum oversees a $50 million annual budget and a staff of 950.

From Toronto, **Donald F. Taylor,** '50, writes that as a volunteer consultant with the Canadian Executive Service he is helping place retired and semi-retired professionals in third-world assignments where problem-solving help has been requested. "We have 2,200 volunteers on our roster," he writes, "annually doing roughly 1,000 projects in Canada and 100 different countries overseas. Very exciting and satisfying," Taylor says. . . . **Frederick L. Merrill, Jr.,** M.C.P.'80, reports that he has left Sasaki Associates, Inc., where he was a senior associate responsible for managing the planning of several large mixed-use development projects. He is now an associate vice-president of the Robbins Group, a real estate development firm in Cambridge, where he is "managing the public approach, design, and construction process for several large-scale development projects," Robbins writes.

The death of **Rajinder N. Chanda,** '64, of Chapel Hill, N.C., on May 17, 1986, has been reported to the Alumni Association; details are not available.



M. McNutt

XII EARTH, ATMOSPHERIC AND PLANETARY SCIENCES

M.I.T. professor **M. Gene Simmons** turned his knowledge of rocks to unusual purpose last summer. Asked to examine scratches cut into the Vietnam War Memorial in Washington, apparently by vandals, he told reporters there was no permanent damage. "The fix is really just a simple polish. You can polish out the scratches on stone just the way you do on furniture."

Ru-Shan Wu, Ph.D.'84, formerly at the University of California, Santa Cruz, is now working at the Institute of Geophysics of the Chinese Academy of Sciences, Beijing. . . . **Teresa S. Bowers,** research scientist at M.I.T., is spending the current year at Harvard under the National Science Foundation's Visiting Professorships for Women program; her Harvard work will focus on the geochemistry of ore deposition. . . . **Michael R. Nelson,** Ph.D.'88, is serving as a Sea Grant fellow with the Senate's Subcommittee on Science, Technology and Space. . . . **Daniel A. Nolet,** S.M.'78, is now manager of thermal process engineering on the corporate engineering staff of Corning Glass Works, Corning, N.Y.; he joined Corning in 1979.

Hans Thomas Rossby, Ph.D.'66, professor of oceanography at the University of Rhode Island, shared the Woods Hole Oceanographic Institution's 1988 Henry Bryant Bigelow Award, cited for "creative contributions to ocean technology and oceanography." Rossby worked with co-winner Douglas C. Webb in developing the SOFAR (sound fixing and ranging) float used to study ocean circulation and sound transmission. . . . The 1988 Macelwane Medal of the American Geophysical Union came late last spring to **Marcia McNutt,** associate professor of marine geophysics at M.I.T. The award is for significant contributions to geophysics by young scientists; McNutt has been at M.I.T. since 1982, four years after she



In a career filled with honors, this one must rank near the top: the National Medal of Technology given by President Reagan to Institute Professor Harold E. Edgerton, Sc.D.'31, at the White House on July 15. Edgerton was cited "for the invention of the electronic stroboscopic flash and for finding a multitude of applications for it within science, technology, and industry." In the background of this picture is Presidential Science Adviser William R. Graham.

Another winner was Paul M. Cook, '47, chairman and CEO of Raychem Corp., Menlo Park, Calif.

PHOTO: MARY ANNE FACKELMAN-MINER

received her Ph.D. at the Scripps Institution of Oceanography for studies of how changes in surface loads affect the behavior of the earth's crust.

Pressed to predict rain for the nation's drought areas last summer, **Donald Gilman,** Ph.D.'57, chief long-range forecaster for the National Weather Service in Washington, had few words of comfort. "We think of ourselves as odds-makers, not prophets," he told the press. The state of the art restricts him to giving only odds, not forecasts, he explained.

Lieutenant Colonel **Brent F. Walker** (U.S.A.F., Ret.), S.M.'57, died on April 17 at the age of 71 in Freeport, Fla.; he studied meteorology at M.I.T., but further details are not available.

XIII OCEAN ENGINEERING

Professor **Martin A. Abkowitz,** '40, who's been teaching ship hydrodynamics, stability and control at M.I.T. since 1949, has retired with the title of professor emeritus. After finishing his undergraduate program at the Institute, Abkowitz worked for the Army Transport Corps and the David Taylor Model Basin for seven years. Then he returned to Cambridge for graduate study at Harvard and joined the Institute staff in 1949; he's been at the Institute ever since, except for leaves of absence to teach in Denmark (1962), Brazil (1970), France (1971), Singapore (1978), Israel (1979), and at the U.S. Naval Academy (1985). Abkowitz was director of the Ship Model Towing Tank for many years beginning in 1951 and was chairman of the department's graduate admissions committee starting in 1975.

In addition to his teaching in the department at M.I.T., Professor **Douglas A. Carmichael** is now faculty director of the Institute's Minority Introduction to Engineering and Science program (MITES).

The background of **Sherman Reed,** N.E.'55, may not have precisely prepared him for the job, but "we knew he was experienced in construction and was a graduate of Annapolis and M.I.T.," explained Orleans, Mass., selectman Frederick Plumb. So last summer they asked Reed to be acting construction coordinator for a septic waste treatment plant being built for three towns on southeastern Cape Cod.



F. Modigliani

XIV ECONOMICS

Franco Modigliani has retired from full-time teaching at M.I.T. with the title Institute Professor Emeritus; he's continuing part-time teaching. Modigliani came to the U.S. at the beginning of World War II with a doctor's degree in economics from the University of Rome; he arrived at M.I.T. in 1960 as a visiting professor and became a member of the faculty two years later. He has won countless honors—the most prestigious being the Nobel Prize in economics for 1985—for his work on monetary theory, capital markets, and corporate finance.

David A. Garvin, Ph.D.'79, of Harvard Business School is the author of *Managing Quality: The Strategic and Competitive Edge* (Free Press—Macmillan, 1988). The book fulfills what the publishers call "Garvin's credo": "If quality is to be managed, it must first be understood." Another newly published author is **Halbert White,** Ph.D.'76, professor of economics at the University of California at San Diego. *A Unified Theory of Estimation and Inference for Nonlinear Dynamic Models* (Basil Blackwell, 1988), written with Professor A. Ronald Gallant of North Carolina State University, is a modern and unified treatment of econometric theory. Honorary degrees came last June to Professor **Paul A. Samuelson,** from Tufts University, and to **Vincent A. Fulmer,** S.M.'53, from Hawthorne College, Antrim, N.H., of which he was retiring as president. . . . **Armand V. Feigenbaum,** Ph.D.'51, president of General Systems Co., is an overseer of the Malcolm Baldridge National Quality Award Program, which cites American businesses that dramatically improve the quality of their products.

XV MANAGEMENT

Howard W. Johnson, who began his M.I.T. career on the faculty of the Sloan School and went on to become president and chairman of the Corporation, has an important new job: he is chairman of the Board of Trustees of the Alfred P. Sloan Foundation, New York. Johnson retains two titles at M.I.T.: honorary chairman of the Corporation and special faculty professor.

New appointments:

□ **John C. Reid,** S.M.'74, formerly senior vice-president—marketing, is now Coca-Cola's senior vice-president—planning and development.

□ **Joseph J. Murphy,** S.M.'61, has relinquished his title as vice-president and controller of United Air Lines but remains manager—introspect of UAL Corp., Chicago.

□ **Bertram C. Shlensky,** Ph.D.'70, is now president, Cluett Shirt Group, Cluett, Peabody and Co., New York; he was president of the Apparel Fabrics Division, West Point Pepperell, also in New York City.

□ **Dennis B. Sullivan,** S.M.'86, of Framingham is manager of the accounting firm of Greenberg, Rosenblatt, Kull and Bitsoli, P.C., Worcester, Mass.

□ **Matthew D. Breitenberg,** S.M.'77, formerly manager of business planning and development for the Structural Products Division, has been advanced to general manager of planning for Bethlehem Steel Corp.

□ **Joseph P. Carroll,** S.M.'66, has moved from New York, where he was president of Pacific Capital Development Resources, to Billerica, Mass., to be chairman and CEO of Cambridge Medical Technology Corp.

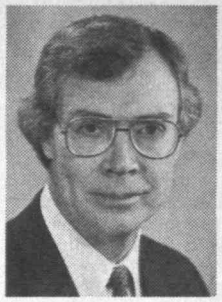
□ **Michael Owen,** S.M.'63, resigned as chairman, CEO, and director of Royal Gold, Inc., Denver; future plans were not announced.

□ **Robert C. Musser,** S.M.'64, formerly controller and treasurer of Mobil's Exploration and Producing Division, is now controller of Mobil Corp., New York.

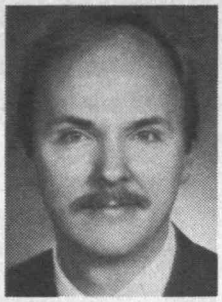
□ **Philip R. Marsilius,** S.M.'48, chairman of Producto Machine Co., Bridgeport, Conn., is now also chairman of the Connecticut Energy Corp., Bridgeport.

Allan W. Karp, S.M.'83, vice-president of Morgan Stanley and Co., Inc., New York, has been elected a director of Colt Industries. . . . His pioneering work in system dynamics brought **Jay W. Forrester,** S.M.'45, Germeshausen Professor, an honorary L.H.D. degree from the State University of New York at Albany.

From **Jon E. Einsidler,** S.M.'74, comes word of the death of a classmate, **Paul Kalikstein,** S.M.'74, in an automobile accident on March 12. Kalikstein was president of the Promotion Network, New York; Einsidler describes him as "a wonderful loving husband, father, and friend with a great lust for life. He leaves his wife Joan and three children, Beth, Jeffrey, and Lori."



C.P. Fletcher



M.D. Breitenberg

Sloan Fellows

Elizabeth Ann Zinser, S.M.'82, was president-elect of Gallaudet University, Washington, D.C., the world's only liberal arts college for the deaf, last spring. But she eventually declined the appointment after students, faculty, and alumni attracted wide public attention to their protest of the naming of a hearing person to the post. Zinser continues as vice-president for academic affairs at the University of North Carolina, the post she held when selected to be president of Gallaudet.

"You will always be a student. . . . You're simply moving from one classroom with a clear curriculum to one without walls . . . and much ambiguity," **Richard Santagati,** S.M.'79, told 573 graduates of Merrimack College, North Andover, Mass., last June as their commencement speaker. Santagati, who had graduated from Merrimack 23 years earlier, is chairman and CEO of the law firm of Gaston Snow and Ely Bartlett, Boston.

Two changes for Sloan alumni at BellSouth Corp., Atlanta: **Jere A. Drummond,** S.M.'79, formerly senior vice-president for services, is now senior vice-president—marketing; and **Michael K. Harrell,** S.M.'82, who was president of BellSouth's equipment marketing unit, is now vice-president for federal government and strategic account sales.

Charles P. Fletcher, S.M.'73, has advanced to vice-president—engineering at Aluminum Co. of America; he was formerly vice-president—manufacturing in Alcoa's Aerospace and Industrial Products Group. . . . **Ray W. Ballmer,** S.M.'60, has moved from chairman and COO to vice-chairman of Rio Aglom, Ltd., Toronto. . . . At General Motors, look for **Donald L. Runkle,** S.M.'76, in the advanced engineering staff in Warren, Mich., where he's now vice-president; Runkle was formerly director of advanced vehicle engineering in Pontiac, Mich. . . . Formerly chairman and CEO at Cullinet Software, Inc., Westwood, Mass., **David L. Chapman,** S.M.'70, is now president and CEO at Computer Power Group of America, a subsidiary of the Australian company of the same name.

Two changes at Grumman Corp., Bethpage, N.Y.: **Peter B. Oram,** S.M.'71, has advanced from senior vice-president to president of the Aircraft Systems Division; and **Ronald B. Peterson,** S.M.'73, formerly president of Grumman Allied Division, is executive vice-president of the Aircraft Systems Division.

William G. McGagh, S.M.'65, has retired from Northrop Corp., Los Angeles; he was senior vice-president—finance and chief financial officer. . . . **J. Thomas Parmeter,** S.M.'79, has resigned as chairman of Syntro Corp., San Diego, to form his own technology development company. . . . And **John P. Eberhard,** S.M.'59, has left the Building Research Advisory Board of the National Academy of Sciences to pursue a career as an artist in Bethesda, Md.

An important honor for **Richard G. Rhoades,** S.M.'77, associate director of the Army Missile Command's Technology, Research, Development and Engineering Center, Redstone Arsenal, Ala.: a 1988 Presidential Rank Award recognizing excellence in the federal senior executive service.

B. Chester Tanner, S.M.'57, died in Edmonton





C.O. Magnell *R.G. Rhoades*

on June 14. He was president and CEO of three Alberta companies, Tanner Arctic Oil, Ltd., Lassiter Kuma Oil, Ltd., and Polled Cattle Corp., Ltd., and he was active in Edmonton civic affairs. Tanner's son, **James,** S.M.'84, was also a Sloan Fellow, and the family believes James may be the first son of a Sloan Fellow to follow in his father's footsteps.

Senior Executives

From poolside at his summer home in Atkinson, N.H., came a letter from **William G. Scheerer,** '83, who has a new job with AT&T Bell Laboratories, Holmdel, N.J.—executive director of production realization and international planning. The family has therefore moved to a new home in Morganville, N.J. Bill's responsibilities include the Quality Assurance Center, operations research and product realization work, and development of R&D strategies for the international arena. He expects fewer short trips but a few longer ones, of which he cites two examples: five European countries in a two-week tour, and another itinerary that included—in the order given—London, Tokyo, and Bonn.

XVI AERONAUTICS AND ASTRONAUTICS

An honorary L.H.D. degree came to M.I.T. Professor **Robert W. Simpson,** Ph.D.'64, at Hawthorne College, Antrim, N.H., last spring. (Hawthorne is devoted to preparing its students for aviation industry careers.) . . . Two members of the department community planned to give papers at the 39th International Astronautical Congress of the IAF in Bangalore, India, in October: **Byron K. Lichtenberg,** Sc.D.'79, of Payload Systems, Inc., Wellesley, Mass., on measuring acceleration in space-based materials science experiments; and M.I.T. Professor **Edward F. Crawley,** Sc.D.'81, on low-gravity dynamics.

Albert J. Kelley, Sc.D.'56, has moved from Arthur D. Little, Inc., where he was senior vice-president—financial and economic analysis, to United Technologies Corp., Hartford, to be senior vice-president—strategic planning.

XVII POLITICAL SCIENCE

To **William E. Griffith,** Ford International Professor at M.I.T., the Commander's Cross of the Order of Merit of the Federal Republic of Germany. "Using his sharp intellect and . . . expertise to reach a widespread American public," said the citation to Griffith, "he has fostered the understanding of political developments in Germany and thus helped to improve German-American relations."

Vincent Ferraro, Ph.D.'76, former board member of the World Affairs Council, was among speakers in a seminar series sponsored by the World Affairs Council of Western Massachusetts late last spring. . . . The U.S. Army Construction Engineering Research Laboratory at Champaign, Ill., is now under the command of Colonel **Carl O. Magnell** (U.S.A.), S.M.'71; his most recent previous assignment was assistant chief of staff, Eighth U.S. Army, Seoul, Korea.

XVIII MATHEMATICS

Three awards came to members of the M.I.T. mathematics community last spring and summer from the American Mathematical Society: a Centennial Research Fellowship to Professor **Steve Bell,** Ph.D.'80, of Purdue . . . the 1988 Steele Prize for Expository Writing to M.I.T. Professor **Sigurdur Helgason** . . . and the 1988 Steele Prize for a Fundamental Paper to M.I.T. Professor **Gian-Carlo Rota.**

M.I.T. Professor **Richard D. Schafer** has retired with the rank of professor emeritus after 28 years at M.I.T. Schaefer taught at the Universities of Michigan and Pennsylvania before coming to the Institute, where he was deputy head of the department from 1959 to 1968; his research and publications have been in the field of conventional and unconventional algebras.

Lowenthal Francis, Ph.D.'74, reports that he teaches logic and applications of logic to psychology as professor at the University of Mons, Belgium; he is also director of a laboratory studying the use of nonverbal communication devices in psychology and education. . . . From Pasadena comes a note from **Robert P. Thurstans,** Sc.D.'87: "I've just started work at Jet Propulsion Laboratory (as of June). Learning lots of statistics and soaking up the sunshine!"

XX APPLIED BIOLOGICAL SCIENCES

Aaron L. Brody, Ph.D.'57, has been named winner of the Institute of Food Technologists Food Packaging Division 1988 Riester-Davis Award. Brody is being honored for contributions that include development of controlled atmosphere processing and packaging and plastic film multiple packaging.

Charles J. Bates, Ph.D.'57, was one of six food scientists to be named as Fellows of the Institute of Food Technologists. Bates is vice-president of American Maize Products of Hammond, Ind. . . . **Thomas K. Skopek,** Ph.D.'80, has developed a method for determining the molecular nature of mutations induced *in vitro* and *in vivo* in human DNA sequences by acquiring model mutagens and characterizing their effects on certain segments of DNA. He presented these findings in the April 1988 Chemical Industry Institute of Toxicology newsletter.

M.I.T. Institute Professor **Nevin S. Scrimshaw,** who is a major figure in international nutrition research and planning, has retired with the title of professor emeritus. Scrimshaw came to the Institute in 1961 to head the then Department of Nutrition, Food Science and Technology after having been director of the Institute of Nutrition of Central America and Panama since 1949. He won the first James R. Killian Faculty Achievement Award in 1973.

XXI HUMANITIES

M.I.T. Associate Professor of History **William Braasch Watson** appeared as a guest editor for a special issue of *The Hemingway Review,* which was devoted entirely to Hemingway's involvement in the Spanish Civil War. Watson, an authority on the war, helped to edit original drafts of Hemingway's surviving dispatches during his stint as correspondent. The intent was to correct the thousands of errors and changes introduced into Hemingway's writing by cable operators and rewrite editors, and restore, as much as possible, the original cadences and rhythms of Hemingway's prose.

To **Peter C. Perdue,** associate professor of history at M.I.T., the 1988 Harold E. Edgerton Award for distinction in teaching, research, and service to the M.I.T. community. Perdue was cited as a "master teacher" and for "achievements as a contemporary historian of China." He holds three degrees from Harvard (B.A.'70, M.A.'73, and Ph.D.'81) and first came to M.I.T. as an instructor in 1980.

Leo Marx, William R. Kenan Professor of American Cultural History at M.I.T., is co-editor of *The Railroad in American Art* (M.I.T. Press, 1988) and contributed to the book an essay on how railroad imagery has been used by American artists to represent a variety of deep social and cultural concerns.

XXII NUCLEAR ENGINEERING

John W. Keffer, S.M.'88, is a nuclear engineer for Commonwealth Edison Company of Chicago. . . . **James H. Wicks,** S.M.'87, is a nuclear repair officer at the Pearl Harbor Naval Shipyard in Hawaii. . . . **Andrew A. Dykes,** Ph.D.'82, writes: "Following 4 years as associate professor of nuclear engineering at West Point, I retired from the U.S. Army and joined the firm of Pickard, Lowe, and Garrick, Inc., as a senior consultant."

Ray A. Rothrock, S.M.'78, recently graduated from Harvard Business School with an M.B.A., and is joining Venrock Associates in New York. . . . **Dennis R. Spurgeon,** Nuc.E.'69, was elected chairman and CEO of Swiftships, Inc., a leading manufacturer of high-speed patrol boats for international coast guard and navy applications.

Shelby T. Brewer, Ph.D.'73, was appointed executive vice-president of the nuclear power systems group at Combustion Engineering in Windsor, Conn. Before joining Combustion Engineering in 1984, Brewer was assistant to the secretary of energy for the Reagan administration.

XXIV LINGUISTICS AND PHILOSOPHY

Marcellus S. Snow, S.M.'67, a professor of economics at the University of Hawaii at Manoa, has written three books in the past two years: *Marketplace for Telecommunications, Telecommunications Economics and International Regulatory Policy,* and *The International Telecommunications Satellite Organization.* . . . **Marie L. Ludwig,** S.M.'69, is a technical writer for administrative systems development at M.I.T.

TPP TECHNOLOGY AND POLICY PROGRAM

Clint Stanovsky, S.M.'81, has relocated to Seattle and is working in solid waste policy.

Births: **David Dorau,** S.M.'87, has a new son, Cory David, born June 17, 1988. Also, **Grace Chen** gave birth to a son, Alvin, in April.

With apologies for tardiness, we report with pride that M.I.T.'s Irwin W. Sizer Award came to the Technology and Policy Program at the annual Awards Convocation last May. The citation called attention to the innovative character of the T+P program and to its very special role in M.I.T.'s educational offerings.

Joan Winston, S.M.'82, is hard at work as project director for a new study on "Copyright and Home Copying" for the U.S. Office of Technology Assessment. . . . From Indonesia, **Isna Soedjatmoko,** S.M.'87, reports that he is working as a program specialist in the organization responsible for managing Indonesia's environment and national resources. His work entails developing and monitoring projects and building ties with the Indonesian government, the USAID Mission, and other donor agencies.—Richard De Neufville, Ph.D.'65, chairman, Room 1-138, M.I.T., Cambridge, MA 02139

Russell DeYoung, 1909-1988

Russell DeYoung, S.M.'40, former chairman of Goodyear Tire and Rubber Co. who was a life member emeritus of the M.I.T. Corporation, died at his home in Naples, Fla., apparently of heart failure, on May 30. He was 79.

DeYoung studied at M.I.T. under a Sloan Fellowship in 1939-40, thereafter returning to Goodyear as executive vice-president of its aircraft subsidiary. Under his leadership, Goodyear Aircraft Corp. became one of the nation's largest producers of planes during World War II. By 1956 DeYoung was executive vice-president of the parent company, becoming president in 1958 and chairman and chief executive officer in 1964. He retired in 1974, retaining his post as director and chairman of the executive and finance committees until 1979.

First elected to the M.I.T. Corporation in 1959, DeYoung became a life member in 1964 and transferred to emeritus in 1979.

Manfred Rauscher, 1905-1988

Word reached M.I.T. during the summer of the death of Manfred Rauscher, '27, at his home in Zurich, Switzerland, last January 15; he was 83.

Rauscher held three degrees in mechanical engineering at M.I.T.—S.B., S.M. (1927), and Sc.D. (1936). He joined the Institute's teaching staff in aeronautical engineering upon receiving his bachelor's degree, and he continued until 1950, when he returned to his native Switzerland.

A specialist in aerodynamics, Rauscher was the author of an influential book, *Aeronautical Dynamics*, and for a number of years he directed the Flutter Laboratory at M.I.T., devoted to the study of aerodynamic instabilities in aircraft.

Deceased

The following deaths have been reported to the Alumni Association since the *Review*'s last deadline:

Benjamin Madero, '06; July 12, 1974; Coahuila, Mexico.
Otto W. Hilbert, '15; July 31, 1988; Corning, N.Y.
Samuel Freed, '17; July 7, 1988; Worcester, Mass.
Mrs. Richard T. Lyons, '17; 1984; Houston, Tex.
George W. Anderson, '20; October 2, 1987; Kingsville, Md.
Boris V. Korvin Kroukovsky, '21; June 20, 1988; East Randolph, Vt.
Elliott B. Roberts, '21; July 15, 1988; McLean, Va.
Marshall J. Root, Jr., '21; March 28, 1988; Geneva, N.Y.
Leland E. Thomas, '22; May 17, 1988; Belmont, Mass.
Francis L. Tobin, '22; June 1988.
Gerald A. Fitzgerald, '23; July 3, 1988; Lakeville, Conn.
Minnie B. Chapman, '24; December 23, 1985; Saugus, Mass.
Irving L. Lind, '26; January 1987; Oak Harbor, Wash.
Manfred Rauscher, '26; January 15, 1988; Weesen, Switzerland.
Robert W. Sherwood, '26; April 9, 1988; San Juan, P.R.
James P. Warner, '26; May 5, 1988; Baton Rouge, La.
Curtis R. Washburn, '26; June 10, 1988; Cuyahoga Falls, Ohio.
Edward H. Damon, '27; June 15, 1988; Bartlesville, Okla.
Albert S. Walton, '27; May 27, 1988; Newark, Del.
Laurence R. Moses, '29; June 9, 1988; Sarasota, Fla.
Frank C. Fahnestock, '30; May 26, 1988; Zephyrhills, Fla.
Wallace G. Hope, '30; June 24, 1988; Boone, Iowa.
David Landen, '30; May 26, 1988; Coconut Creek, Fla.
Maurice W. Mayer, '30; 1973.
Leon S. Thorsen, '30; May 21, 1988; Ellsworth, Maine.
John J. Hanlon, '33; February 18, 1988; La Jolla, Calif.
Lawrence J. Hubbard, '33; June 15, 1988; Old Lyme, Conn.
Warren D. Ford, '34; July 5, 1988; Weymouth, Mass.
Gregory M. Korjeff, '34; June 18, 1988; Fitzwilliam, N.H.
Horace A. Quinn, '34; March 17, 1983; Provo, Utah.
Robert F. Goodman, '35; June 30, 1988; Winston-Salem, N.C.
Kenneth A. Packard, '36; June 27, 1988; Stratford, Conn.
George D. Ray, '36; May 20, 1988; Anacortes, Wash.
Warren Sherburne, Jr., '36; July 8, 1988; Niantic, Conn.
Milton S. Tarnopol, '36; August 13, 1987; Berkeley, Calif.
Gordon T. Vaala, '36; November 18, 1987; Wilmington, Del.
Robert H. Goldsmith, '37; July 19, 1988; Great Neck, N.Y.
William G. Hockberger, '37; July 15, 1988; University Park, Md.
Robert C. Uddenberg, '37; March 17, 1988; Bellevue, Wash.
George B. Wemple, '37; April 22, 1988; New York, N.Y.
James E. Evans, '38; February 20, 1988; Moylan, Penn.
Blaine F. Fairless, '38; June 20, 1988; Uniontown, Penn.
Charles C. Henes, '38; May 5, 1988; Newton Highlands, Mass.
Ralph E. Hughes, '38; February 20, 1988; Everett, Mass.
Norman C. Chase, '39; May 9, 1988; Palm Desert, Calif.
Ernest L. Schlage, '39; March 1988; Burlingame, Calif.
Charles G. Seifert, Jr., '39; June 30, 1984; Hacienda Edode, Mexico.
Russell DeYoung, '40; May 31, 1988; Naples, Fla.
Schrade F. Radtke, '40; April 9, 1988; New Canaan, Conn.
Divo Louis Tonti, '40; June 5, 1988; Holmdel, N.J.
William G. Williamson, Jr., '40; March 5, 1988; Lexington, Va.
Norman I. Shapira, '41; March 22, 1988; Prince Frederick, Md.
John B. Waller, '41; May 15, 1988; Barrington, R.I.
Mark W. Cauble, '43; March 30, 1988; Atlanta, Ga.
A. Donald Moll, '43; April 15, 1988; Saint Paul, Minn.
Randall D. Esten, Jr., '45; November 18, 1986; Hendersonville, N.C.
William F. Herberg, Jr., '46; June 22, 1987.
James I. Osborne, Jr., '46; June 19, 1987; Puerto Vallarta, Mexico.
Thomas J. Rudden, Jr., '46; March 10, 1986; McLean, Va.
Presson S. Shane, '46; November 10, 1987; Easton, Md.
Leslie C. Merrill, '47; April 1988; San Diego, Calif.
Robert R. Smyth, '47; June 12, 1988; Bloomfield Hills, Mich.
Kenneth C. Bushway, '48; April 6, 1988; Trenton, N.J.
Norman E. Weeks, Jr., '48; 1988.
John H. Wykes, '49; June 20, 1988; Rancho Palos Verdes, Calif.
John R. Bedell, '50; May 24, 1988; Madison, N.J.
Arnold W. Doyle, '50; July 13, 1988; Weston, Mass.
Richard H. Holmberg, '50; July 5, 1988; Landisville, Penn.
Ross R. Quincy, '50; July 30, 1988; Wilton, Conn.
B. William Sauter, '50; April 17, 1988; San Mateo, Calif.
Emanuel S. Criscione, '51; August 12, 1988; Winchester, Mass.
Gerald S. Ikelheimer, '51; June 14, 1988; Piermont, N.Y.
Frederick D. Newell, '51; May 28, 1988; Binghamton, N.Y.
Gerald G. Brown, Jr., '52; November 14, 1987; Potomac, Md.
Howard H. Ferris, '52; August 6, 1988; Concord, Mass.
Oliver E. Hall, '52; March 3, 1988; McLean, Va.
Judith L. Lucas, '52; September 17, 1987; Lexington, Mass.
Orville L. Mageli, '53; November 1987; Kenmore, N.Y.
Charles S. Krakauer, '54; July 15, 1988; Weston, Mass.
Avery R. Johnson, '55; June 21, 1988; Milford, N.H.
Frederick L. Scarf, '55; July 17, 1988; Sherman Oaks, Calif.
Henry D. Tomlinson, '55; June 16, 1988; Jacksonville, Fla.
Arnold H. Nevis, '56; July 4, 1986; Gainesville, Fla.
B(yron) Chester Tanner, '57; June 14, 1988; Edmonton, Canada.
Brent F. Walker, '57; April 17, 1988; Freeport, Fla.
William F. Burke, '59; June 3, 1988.
Louis C. Habegger, '60; April 1988; Uerikon, Switzerland.
Cornelis J.M. Den Dulk, '62; September 18, 1987; Enschede, The Netherlands.
Jin H. Kim, '63; March 27, 1988; Haverford, Penn.
Chester F. Jatczak, '66; December 29, 1986; Canton, Ohio.
George H. Pace, '68; June 5, 1988; Cleveland, England.
Dale A. Griffith, '75; February 16, 1987; Kalamazoo, Mich.
Dale B. Van Laningham, '83; January 12, 1986; Waterbury, Conn.
Andrew G. Morsa, '87; April 4, 1988; Hawthorne, Calif.

ALLAN J. GOTTLIEB

Making Mittens Inside Outside

I am in the very last stages of producing, with George Almasi from IBM, a book entitled *Highly Parallel Computing*. Since we are producing camera-ready copy and work on computer systems with incompatible text formatters (Script and Troff), we have managed to learn more than we might wish about many formatting details. It gives me more appreciation for the effort involved in publishing a book.

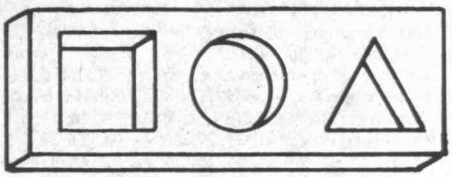
Our supply of computer-oriented problems is very low, so submissions of such problems are encouraged. A full listing of our backlogs is given each April.

Problems

N/D 1. Our first problem this month is computer-oriented. Gordon Rice reminds us that a number in a particular number base is *palindromic* if the digits (leading zeros excluded) read the same right-to-left as left-to-right. For each integer $N > 2$, let $P(N)$ be the least integer exceeding $2N$ that is palindromic both in base N and in base 2. What is the smallest N such that $P(N) > P(3)$?

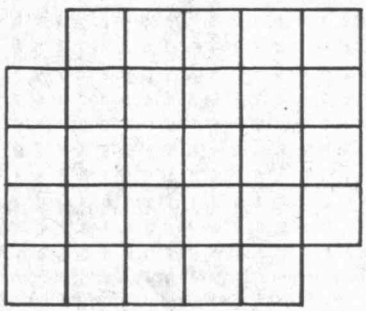
N/D 2. The following problem appeared in the "Gamesman" column of the October 1986 issue of *IEEE Potentials*, where it was attributed to Rajiv Gupta. You encounter three people who know each other. One always tells the truth; one lies all the time; and one gives random answers. How can you tell, by asking only three questions directed to only one person at a time, which is which?

N/D 3. Gary Schmidt and Joe Horton want you to find a single shape that will fit snugly through all three holes in the board shown below. Each edge of the square is the same length as the diameter of the circle and as the bottom edge of the triangle. You are free to specify the other two edges of the triangle as part of your solution.



N/D 4. Frank Rubin wants to know in how many ways the integers from 1 to N can be permuted so that the result consists of a strictly ascending sequence followed by a strictly descending sequence. For example, with $N = 9$ we could have, 1,4,5,7,9,8,6,3,2. [These sequences are sometimes called *bitonic*—ed.]

N/D 5. The following problem, from Solomon Golomb's column entitled "Golomb's Gambits," appeared in the October 1987 issue of *Johns Hopkins Magazine*. Find four ways to divide the figure below into 4 congruent pieces.



Speed Department

SD 1. Jim Landau forgot the last line of the following poem:

Of the skin he made him mittens
Made them with the fur side inside
Made them with the skin side outside
He, to get the warm side inside,
Put the inside skin side outside
He, to get the cold side outside
Put the warm side fur side inside
That's why he put the fur side inside
Why he put the skin side outside
. . .

SD 2. Mark Astolfi had one plate appearance during an inning of baseball



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and walked. What is the largest number of bases he could have stolen during that inning?

Solutions

JUL 1. Write an efficient computer program for searching for positive integer solutions to the equation
$x^3 + y^3 + c = z^3$
and list all values of c between 0 and 100 for which you find solutions. You will need to bound x and y (thereby bounding z). Efficiently searching all values less than a few thousand is a modest (but not trivial) computation.

The most complete solution is from the Richard Hess, who writes:
A small program that loops on x and y finds
$z = [(x^3 + y^3)^{1/3}] + 1$,
and determines whether
$C = z^3 - x^3 - y^3 \leq 100$,
was run in double precision on my PC for a few hours to check $x, y \leq 5000$. The values of c for which there were solutions are 1, 2, 6, 7, 8, 9, 10, 11, 15, 16, 17, 18, 19, 20, 21, 25, 27, 28, 29, 34, 35, 36, 37, 43, 44, 46, 47, 48, 53, 54, 55, 56, 57, 60, 62, 63, 64, 65, 69, 70, 71, 72, 73, 78, 79, 80, 81, 82, 83, 87, 88, 90, 91, 92, 93, 97, 98, 99, and 100.

Also solved by Winslow Hartford, Harry Zaremba, and the proposer, Matthew Fountain.

JUL 2. Solve the following Naymandidge from Neil Macdonald's Puzzle column in the September-October issue of *Computers and People*:
In a naymandidge, an array of random or psuedo-random digits ("produced by *nature*"), such as that at the bottom of this column, has been subjected to a "definite systematic operation" ("chosen by *nature*"). The problem ("which *man* is faced with") is to figure out what was *nature's* operation. A "definite systematic operation" meets the following requirements: the operation must be performed on all the digits of a definite class which can be designated; the result must display some kind of evident, systematic, rational order and completely remove some kind of randomness; and the operation must be expressible in not more than four English words. (But *man* can use more words to express the solution and still win.)

4 8 0 1 8 9 1 7 5 1 0 4 4 6 2 1 7 4 7 7
5 1 8 6 4 8 9 1 4 4 3 0 0 4 2 1 0 9 8 7
9 3 2 9 9 6 5 2 3 5 6 0 5 8 2 2 9 7 5 0
4 9 6 2 4 8 7 7 5 3 6 4 5 0 7 1 9 7 9 3
8 0 1 5 0 2 9 4 6 0 9 9 4 3 3 1 1 6 7 0
8 5 7 8 6 6 2 2 4 6 9 8 7 5 8 1 7 9 2 1
4 7 4 3 8 7 4 7 6 1 1 5 6 1 4 2 8 4 0 4
0 5 4 1 7 4 1 5 2 1 1 2 7 0 3 2 2 7 9 3
6 8 9 9 2 2 9 4 6 7 7 2 4 1 0 1 6 8 6 8
2 6 6 7 8 0 9 7 6 5 1 7 8 4 3 2 0 1 0 0

The only submission is from Matthew Fountain, who notes that the sixteenth column contains only 1 and 2 and thus conjectures that nature's operation was to replace the old value x in the sixteenth column by $(x \bmod 2) + 1$.

JUL 3. To a pure sinusoidal tone, add a second pure sinusoidal tone of identical amplitude and frequency but with a random phase shift. What is the probability that the resulting sound is lower in volume than the original tone?

The following solution is from John Prussing:
The function can be expressed as $f = \sin(t) + \sin(t + k)$. This is equivalent to $f = (1 + \cos k)\sin(t) + \sin(k)\cos(t)$, which has an amplitude A given by $A^2 = (1 + \cos k)^2 + (\sin k)^2 = 2(1 + \cos k)$.
For this amplitude to be less than one requires that $\cos k < -1/2$, which is satisfied by $2\pi/3 < k < 4\pi/3$. Assuming a uniform probability density for the random variable k on the interval $0 < k < 2\pi$ results in a probability equal to 1/3.

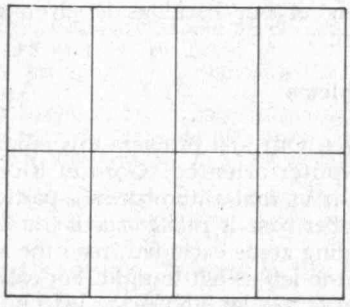
Also solved by Alan Taylor, Richard Hess, Matthew Fountain, Ken Rosato, Winslow Hartford, Harry Zaremba, Daniel Morgan, Steven Feldman, Brian McCue, and the proposer, Dave Mohr.

JUL 4. A doubly palindromic number would be a number N that is palindromic when expressed in each of two bases p and q, where gcd(p,q) = 1 and N exceeds the product pq. Are there any such N? If so, is there a largest?

The following solution is from Linda Klaver:
An example of a doubly palindromic number is 52. Let p = 3 and q = 5. Then (p,q) = 1, and 52 is written 1221 in base 3 and 202 in base 5. There is no largest number N which is doubly palindromic. To show this, let p be any integer greater than 3 and let q = p + 1. Then (p,q) = 1. Take $N = q^2 + pq + 1$. In the base q, N is written 1p1, which is palindromic. Expressed as a polynomial in p,
$N = (p + 1)^2 + p(p + 1) + 1$
$= p^2 + 2p + 1 + p^2 + p + 1$
$= 2p^2 + 3p + 2$.
In the base p, therefore, N is written 232, which is palindromic. Note that the general solution does not work for p = 3, because $3p = p^2$. In the general solution, if p = 3, then q = 4 and N = 29. In the base 3, N is written 1002, which is not palindromic.

Also solved by Avi Ornstein, Richard Hess, Matthew Fountain (who also considered numbers palindromic in three bases), Ken Rosato, and Gordon Rice.

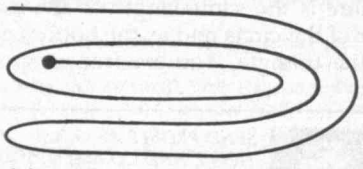
JUL 5. Take an 8½ × 11 inch piece of paper (preferably with writing on both sides) and fold it in half three times, as if you were about to store it into your shirt pocket. Now unfold it. If you are like most of us, the fold lines will separate the paper into two rows of four rectangles all of which are identical:



In how many unique ways can you completely fold up the paper, assuming that you only make flat folds along the fold lines? Now suppose you had a strip of paper containing one row of six rectangles. How many ways can you fold that? What are the odds that the large map inside your automobile glove compartment is correctly folded?

Our last solution is from Matthew Fountain:
There are 264 ways of folding the paper into eight rectangles. There are 140 ways of folding the strip into a six-rectangle stack. The probability my map is folded correctly is about 0.5 when new and very small when old.

I explain the second part of the problem first, as the case of all folds along parallel axes is less complicated. I classified the distinct ways of folding the six rectangles into a six-layer stack according to the direction of the creases observed after the strip was unfolded. For example, there are seven foldings that leave the crease pattern RRRLL. To find these I marked the upper face of the first rectangle of the strip and numbered the creases from this point on from one to five. Next I drew a rough sketch of one folding (shown below) by drawing a horizontal line



from left to right to represent an edge view of the first rectangle. I then reversed the continuation of this line with a right, or R, turn and drew a second horizontal line below the first from right to left to represent the edge view of the second rectangle. I again reversed the direction of the line with another R turn and drew the edge view of the third rectan-

gle. I chose to draw this above the first and second rectangles, but noted my next sketch would place the line between them. I again reversed the direction of the line with a third R turn and drew the fourth rectangle. The fifth and sixth rectangles were drawn following left turns so that the series of turns for a traverse of the line was RRRLL. A second sketch was made by retracing the first up to the point that I had noted and then proceeding on between the first and second rectangle. With a little attention one can discover all the possible foldings that yield a given pattern of turns or creases. Of the $2^5 = 32$ possible patterns it is necessary to only determine the number of folds corresponding to 10 patterns as patterns with mirror symmetry have the same number of folds. For example, RRRLL, LLLRR, RRLLL, and LLRRR all have 7 distinct ways of folding. The tabulation below shows that the 16 patterns starting with an R have a total of 70 folds. The 16 patterns starting with L are mirror images of the R patterns. Therefore there are 140 distinct ways of folding six rectangles into a stack.

Pattern	No. folds	Pattern	No. folds
RRRRR	5	RLRRR	5
RRRRL	5	RLRRL	3
RRRLR	5	RLRLR	1
RRRLL	7	RLRLL	3
RRLRR	5	RLLRR	4
RRLRL	3	RLLRL	3
RRLLR	4	RLLLR	5
RRLLL	7	RLLLL	5

The paper folded into eight rectangles by three parallel creases and one at right angles is more complicated. It is wise to check by actually folding a paper. Certain folds require a tuck fold of the sort commonly used to fold newspapers to keep them closed. I tabulated these separately as maps are not usually so folded. I divided the pattern of folds up as follows:

(a) First fold is lengthwise, the rest crosswise. After the lengthwise fold there are 16 continuations without a tuck and 8 ending with a tuck. As the first fold can be made in two ways there are a total of 32 regular foldings plus 16 tuck foldings.

(b) One end of the paper is folded over followed by a lengthwise fold that places the folded end inward. There are 6 continuations without a tuck and 4 with a tuck. As there are two ends and two directions of the first fold, there are 24 regular foldings plus 16 tuck foldings.

(c) Same as (b) but the lengthwise fold is in the opposite direction. There are 6 continuations without a tuck and 8 with a tuck. As there are two ends and two directions of the first fold, there are 24 regular foldings plus 32 with a tuck.

(d) First fold is across the middle of the paper and the second is the lengthwise fold. Only one more fold is made. As each of the three folds may be made in two ways, there are 8 foldings, all without a tuck.

(e) Both ends of the paper are folded over to the same side and the third fold is lengthwise with folded ends inward. There are two continuations. There are a total of 4 foldings, all without a tuck.

(f) Both ends of the paper are folded over to the same side and the third fold is lengthwise with folded ends outward. There are two continuations without a tuck and four with a tuck. There are a total of 4 foldings without a tuck and 8 with a tuck.

(g) Both ends of the end paper are folded over to opposite sides and the third fold is lengthwise. There are two continuations without a tuck and 2 with a tuck. There are 8 foldings without a tuck and 8 foldings with a tuck.

(h) One end is folded over, the middle fold is made, and then the lengthwise fold is made with folded end inward. There are two continuations. There are a total of 16 foldings without a tuck.

(i) One end is folded over, the middle fold is made, and then the lengthwise fold is made with the folded end outward. There are two continuations without a tuck and two with a tuck. There are a total of 16 foldings without a tuck and 16 foldings with a tuck.

(j) The lengthwise fold is made last. There are 16 foldings before the last fold which can be made in two ways. There are a total of 32 foldings without a tuck.

There are in all $32 + 24 + 24 + 8 + 4 + 4 + 8 + 16 + 16 + 32 = 168$ regular foldings and $16 + 16 + 32 + 8 + 8 + 16 = 96$ tuck foldings for a total of 264 foldings.

Also solved by Winslow Hartford, Ken Rosato, and the proposer, Robert Johnson.

Better Late Than Never

F/M 1. Naomi Markovitz has responded.

F/M 4. The following submission is from Daniel Sleator:

I was amused by your note on palindromes. Guy Jacobson—using the dictionary representation described in his article in the May issue of the *Communications of the ACM*—took a crack at creating these. Here are the best ones he found (one word only, no proper nouns). (The comments are Guy's.)

Animal was I ere I saw lamina
(the calming effects of layered materials)
Avid was I ere I saw diva
(a disappointing opera)
Civic was I ere I saw Civic.
(Hondas encourage rude behavior)
Cod was I ere I saw doc.
(my delusion is cured)
Dog was I ere I saw god.
(born again)
Drab was I ere I saw bard.
(Shakespeare leads a whore to culture)
Drawer was I ere I saw reward.
Emir was I ere I saw rime.
(of the Ancient Mariner, perhaps?)
Gelder was I ere I saw redleg.
Live was I ere I saw evil
Ogre was I ere I saw ergo
(something Scherlis might say)
Pacer was I ere I saw recap
Redrawer was I ere I saw rewarder
Reified was I ere I saw deifier
Reined was I ere I saw denier
Repaid was I ere I saw diaper
(a baby's revenge)
Reviled was I ere I saw deliver
Rewarder was I ere I saw redrawer
Smart was I ere I saw trams
Smug was I ere I saw gums
(the heartbreak of gingivitis)
Stinker was I ere I saw reknits
Stressed was I ere I saw desserts
(sugar lowers blood pressure)
Tubed was I ere I saw debut

A different game was played a few years ago in the computer science department here at Carnegie Mellon. Jim Saxe noticed that "a man, a plan, a canal—Panama" could be augmented to form "a man, a plan, a cat, a canal—Panama." Subsequently Dan Hoey created the following monstrosity:

A man, a plan, a caret, a ban, a myriad, a sum, a lac, a liar, a hoop, a pint, a catalpa, a gas, an oil, a bird, a yell, a vat, a caw, a pax, a wag, a tax, a nay, a ram, a cap, a yam, a gay, a tsar, a wall, a car, a luger, a ward, a bin, a woman, a vassal, a wolf, a tuna, a nit, a pall, a fret, a watt, a bay, a daub, a tan, a cab, a datum, a gall, a hat, a fag, a zap, a say, a jaw, a lay, a wet, a gallop, a tug, a trot, a trap, a tram, a torr, a caper, a top, a tonk, a toll, a ball, a fair, a sax, a minim, a tenor, a bass, a passer, a capital, a rut, an amen, a ted, a cabal, a tang, a sun, an ass, a maw, a sag, a jam, a dam, a sub, a salt, an axon, a sail, an ad, a wadi, a radian, a room, a rood, a rip, a tad, a pariah, a revel, a reel, a reed, a pool, a plug, a pin, a peek, a parabola, a dog, a pat, a cud, a nu, a fan, a pal, a rum, a nod, an eta, a lag, an eel, a batik, a mug, a mot, a nap, a maxim, a mood, a leek, a grub, a gob, a gel, a drab, a citadel, a total, a cedar, a tap, a gag, a rat, a manor, a bar, a gal, a cola, a pap, a yaw, a tab, a raj, a gab, a nag, a pagan, a bag, a jar, a bat, a way, a papa, a local, a gar, a baron, a mat, a rag, a gap, a tar, a decal, a tot, a led, a tic, a bard, a leg, a bog, a burg, a keel, a doom, a mix, a map, an atom, a gum, a kit, a baleen, a gala, a ten, a don, a mural, a pan, a faun, a ducat, a pagoda, a lob, a rap, a keep, a nip, a gulp, a loop, a deer, a leer, a lever, a hair, a pad, a tapir, a door, a moor, an aid, a raid, a wad, an alias, an ox, an atlas, a bus, a madam, a jag, a saw, a mass, an anus, a gnat, a lab, a cadet, an em, a natural, a tip, a caress, a pass, a baronet, a minimax, a sari, a fall, a ballot, a knot, a pot, a rep, a carrot, a mart, a part, a tort, a gut, a poll, a gateway, a law, a jay, a sap, a zag, a fat, a hall, a gamut, a dab, a can, a tabu, a day, a batt, a waterfall, a patina, a nut, a flow, a lass, a van, a mow, a nib, a draw, a regular, a call, a war, a stay, a gam, a yap, a cam, a ray, an ax, a tag, a wax, a paw, a cat, a valley, a drib, a lion, a saga, a plat, a catnip, a pooh, a rail, a calamus, a dairyman, a bater, a canal—Panama.

APR 4. Naomi Markovitz has responded.

M/J 1, M/J 2, M/J 4. Thomas Harriman has responded.

Proposers' Solutions to Speed Problems

SD 1. Why he turned them inside outside.
[George A. Strong, *The Song of Milkanwatha*]

SD 2. 6. He entered the game as a pinch runner at first base and stole three bases. The team batted around, he came up, was walked and stole three more.

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DONOR'S PROFILE:



MR. WILLIAM HADWEN AMES
(deceased)

HOME: Easton, Massachusetts

CAREER: In 1879 and 1880 William Ames attended what was then the MIT School of Mechanical Arts in Boston. He was a member of the North Easton, Massachusetts, family whose fortune derived from the Ames Shovel Works. Mr. Ames served as the company's secretary, and later became president of the American Pneumatic Service Company, which manufactured the tubes used to send money and messages within stores and businesses. Like his father, Governor Oliver Ames, he served the Commonwealth of Massachusetts. He was a member of the legislature in 1905-06.

GIFT OF CAPITAL: March 1918 gift to a separate life income trust.

GIFT PLAN: Mr. Ames' trust provided for life income payments to Mrs. Ames and other family members and for a final distribution of a portion of the remaining funds to establish the **William H. Ames Fund** at MIT.

HISTORY: The original gift in trust was $1,050,000. The trust value when Mrs. Ames died on October 19, 1986, was $28,500,000. MIT received $10,500,000 for the **Ames Fund** at the trust's final distribution in 1987.

TAX NOTE: Existing tax law permits the establishment of similar life income trust funds at MIT with no tax on the accumulation of capital.

For more information about gifts of capital, call D. Hugh Darden or Frank H. McGrory at MIT, (617) 253-3827.

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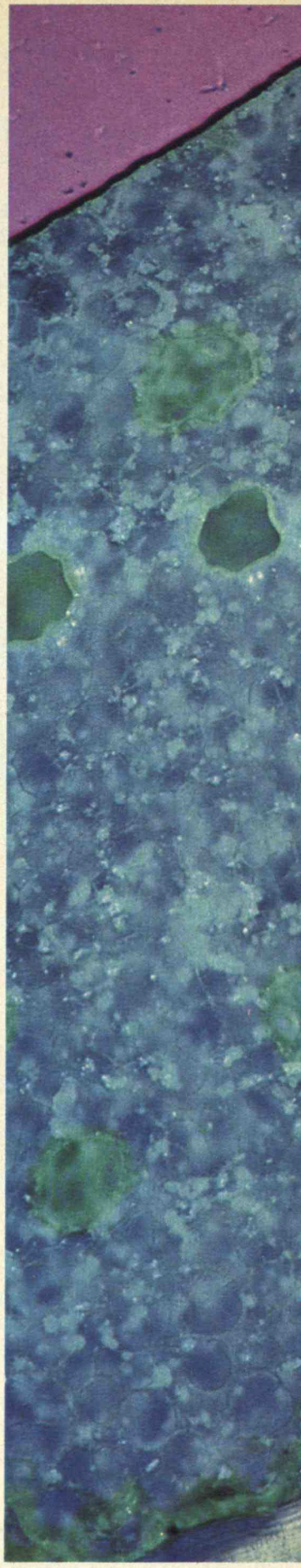
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I Sing the Body Ceramic



HOT, salty, wet, and hostile, the human body reacts swiftly to any foreign substance implanted in it. Few materials are durable and stable enough to withstand the corrosive effects of bodily fluids; of those that can, many trigger adverse biochemical or immunologic reactions.

Scientists have long searched for materials that would elicit as little reaction as possible from the body, in the hope that they could be used to mend or replace human organs, bones, and joints. Suddenly, that search has turned in a different direction: researchers can now create synthetic materials that will provoke highly specific reactions such as tissue growth to enhance the implant's performance. By harnessing the body's own reactive mechanisms, these new materials bring one step closer the dream of permanent, fully implantable artificial organs.

Tissue and fluids within the body will react to any foreign implant. Just how they react, though, depends on a staggering number of variables, including the surface chemistry of the implant, the chemistry of the blood or tissue that will be in contact with it, the design of the synthetic device, and the care with which it is surgically placed within the body.

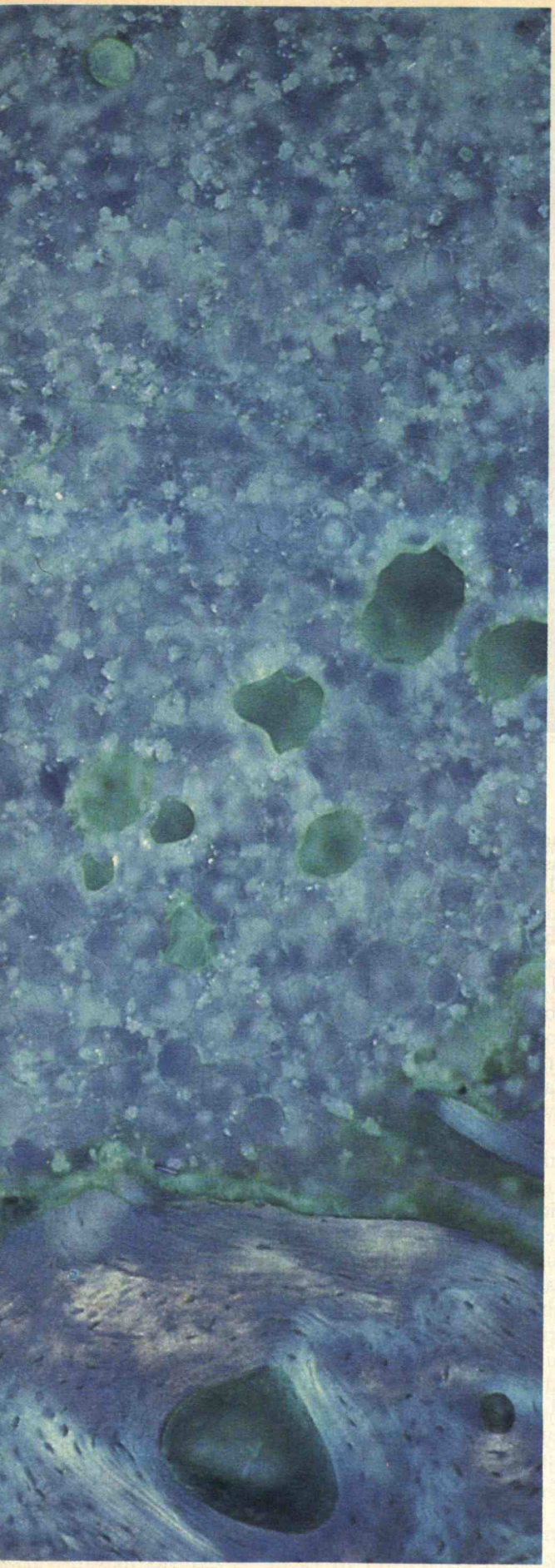
In selecting biomedical materials, researchers naturally shun substances that are carcinogenic, cause allergic reactions, or kill the surrounding tissue. Lead and asbestos, for instance, have no place on the surgeon's palette. In addition, materials that are difficult to fabricate, purify, or sterilize will never be the stuff of successful implants. Finally, biomedical materials must do the job expected of them: intraocular lenses must be clear, bone plates hard, and artificial hips able to bear tremendous stress.

Metals and plastics remain the substances most commonly used in artificial implants. They are strong and durable, and tend to elicit the least reaction from the body. As far back as the 1930s, surgeons used metal pins, screws, and plates to mend broken and shattered bones; during World War II, they began implanting plastic lenses in patients' eyeballs. Less durable materials proved ineffective: efforts to create nylon blood vessels, for instance, were abandoned in the early 1960s, when researchers found that the nylon degraded quickly inside the body.

Today new investigative tools allow scientists to avoid such disastrous failures. Using techniques such as electron spectroscopy for chemical analysis (ESCA), secondary ion mass spectrometry (SIMS), and scanning electron microscopy, researchers can screen a variety of potential new biomaterials. After testing the materials in animals,

BY THOMAS KIELY

New materials for artificial organs are designed to provoke—and harness—the body's reactive mechanisms.



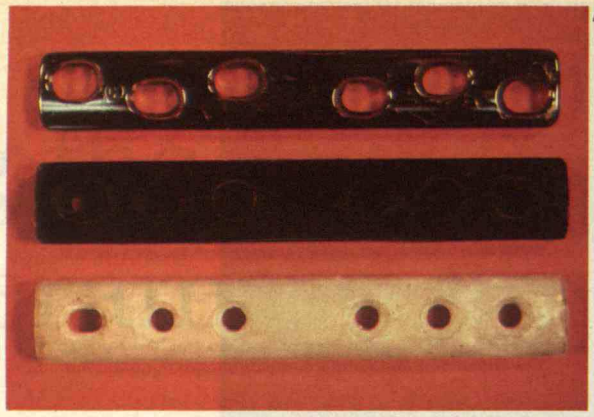


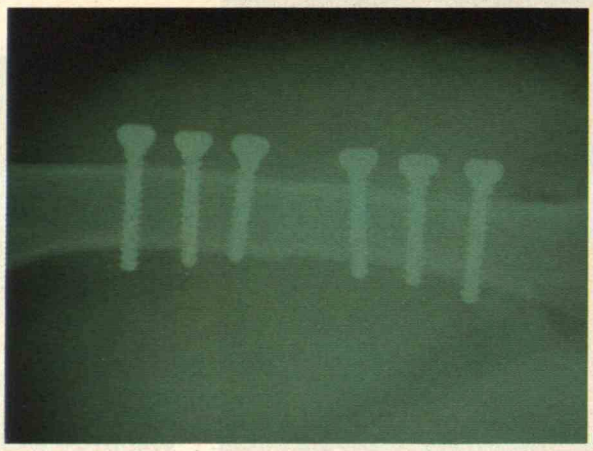


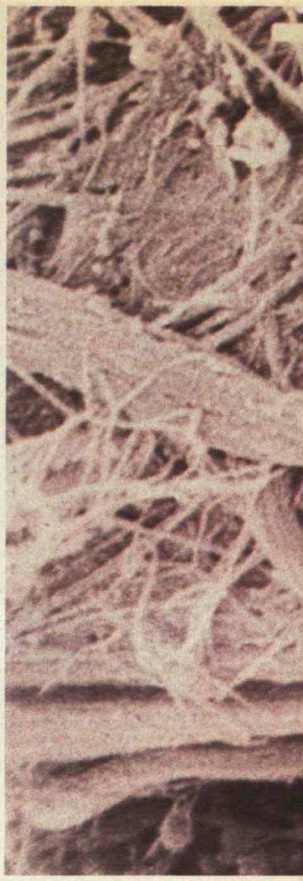
The micrograph at left shows the interface between living bone and polymethyl methacrylate, a polymer used to cement a titanium-alloy hip prosthesis. Promising new bioactive ceramics, which can help bone tissue bond to artificial implants, may replace such polymers. ABOVE: A mixture of ceramic materials used with a hip prosthesis.

Ceramics and collagen, a basic protein, can be combined for dental implants (top). The protein moistens the mixture and allows the implants to be molded and inserted more easily.

Most often associated with kitchenware and cheap suits, Teflon, Dacron, and polyester have found uses ranging from the outermost layers of the skin to the innermost chambers of the heart.







they can recover the implants and inspect the surface with an electron microscope. They can then apply what they have learned from surface analysis and clinical trials to tailor materials that encourage the body to react in ways that strengthen the implant or enhance its functioning. "The future in this area," says Buddy Ratner of the University of Washington, "will lie in the interface of molecular biology and materials science."

So far, the most promising substances are bioactive ceramic materials, which stimulate bone growth, and a wide range of synthetic polymers that can provoke tissue formation or provide protection from the immune system. These materials may also be used to coat plastic or metal devices. A coated hip prosthesis, for example, could combine the bonding ability of ceramics with the strength of the underlying metal.

Bonding to Bone

In some of the most exciting experiments, bioengineers are using calcium-phosphate ceramics to promote bone healing and strengthen artificial joints and bones. Known as osteoconductive or osteophilic (bone-loving) substances, these bioactive materials capitalize on a unique property of bone. "It is the only tissue that heals itself," notes Tobin Gerhart of Harvard Medical School. "The heart, liver, or brain heals as scar, but bone heals as bone."

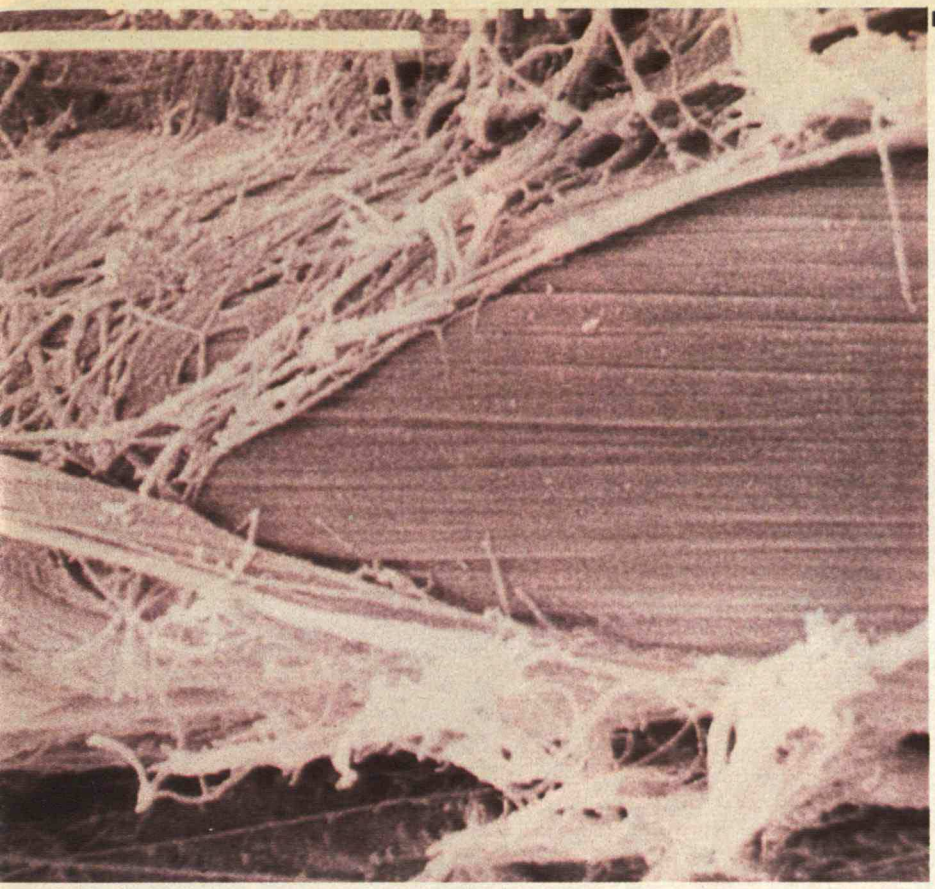
Gerhart explains that osteoconductive materials "facilitate the ingrowth of new bone in an area where bone is likely to grow anyway." Other substances can spark bone growth in muscle or skin tissue, but osteoconductive materials work only in proximity to bone. Shaped into a porous, spongelike form, he says, these substances "could be implanted at a fracture site to act as a scaffold. Bone will grow up to and bond upon the osteoconductive material." As new bone fills in the gaps of this ceramic sponge, it creates a firm and stable intermesh with the ceramic. Though his research is still at the experimental stage, says Gerhart, "the hope is that the ceramic will reabsorb and be replaced by living tissue."

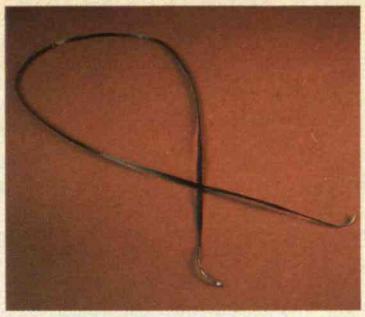
Similar material may be used to coat prostheses, allowing them to bond to bone. Larry Katz of Rensselaer Polytechnic Institute is experimenting with calcium-phosphate ceramics in lower-jaw reconstruction and dental surgery. His work is now being tested in animals.

Researchers at a Palo Alto-based biomedical company are already using a mixture of ceramics and collagen, a fibrous protein, to repair or reshape facial bones. The collagen makes the ceramic material more pliable, while the ceramic encourages the implant to bond. According to Bruce Phariss, vice-president for research at Collagen Corp., a physician using this mixture and computer-aided design techniques could customize facial implants to suit patients' features precisely.

Polymer Supermarket

Like bioactive ceramics, synthetic polymers play an increasingly important role in efforts to improve the performance of artificial implants. Most often associated with kitchenware and cheap suits, materials such as Teflon, Dacron, and polyester have found uses ranging from the outermost layers of the skin to the innermost chambers of the heart. Poly-





Both ceramics and polymers offer advantages over metal in mending fractures. A: The metal bar at top does not degrade; the carbon-and-polymer bar below is partly degradable; the bar at bottom, a polymer-coated ceramic, degrades completely. B: Unfortunately, the screws that attach the plate do not degrade.

C: An artificial ligament is composed of tiny, polymer-coated carbon fibers, to which tissue eventually attaches (D).

meric materials offer researchers a kind of biomedical supermarket: they can choose from a wide variety of available materials, fabricate them in many different shapes and textures, and chemically or biochemically modify the materials to provoke specific reactions.

Some experimental artificial organs, such as the Penn State Total Artificial Heart, are composed almost entirely of polymers and rigid plastics. According to James Donachy of the Hershey Medical Center, the heart implant consists of a rigid plastic case containing an inner blood sac and a diaphragm made of segmented polyurethane, a flexible but durable material. A motorized version of this heart has kept a calf alive for 222 days—a world record among the four or five such organs in existence.

In designing the heart, Penn State researchers used different polymeric materials to achieve different effects. For example, the plastic case is sheathed in a Dacron mesh whose roughness encourages protein absorption and tissue growth to help stabilize the organ in the host body. By contrast, the inner sac is smooth and seamless, allowing blood to wash through the device so as to minimize the threat of blood clots—the biggest problem facing artificial-heart recipients.

Polymers have also been used in artificial skin and in skin patches that secrete controlled doses of medication. Now scientists are using polymers to create implantable drug-release systems that would serve, in effect, as microscopic artificial organs.

Under the direction of Anthony Sun of the University of Toronto, a group of researchers has developed a polymeric material that can protect an artificial pancreas from reaction by the body's immune system. A polymeric membrane encapsulates clusters of pancreatic cells, shielding them from the immune system's otherwise deadly secretions. At the same time, the membrane allows nutrients to filter in and insulin to flow out. Implanted in a diabetic, the organ will work like a natural pancreas, releasing insulin when it senses that glucose levels are high. After several years of testing in animals, the implant will soon undergo clinical trials in humans in the United States and Canada.

Researchers in Sun's group have also developed an artificial liver and an artificial parathyroid, modeled on the artificial pancreas. Another group, at Brown University, is experimenting with an artificial thymus composed of an acrylic membrane housing cells that will secrete thymic hormones.

Despite these advances, the field of biomaterials is just emerging. Among the uses scientists envision for the new biomaterials are surgery-free bone grafting and implants of cancer-fighting drugs. Researchers are already experimenting with ways to inject bioactive ceramics directly into damaged bones, generating new tissue without surgical grafting. Patients with brain tumors, Alzheimer's disease, and Parkinson's disease may someday be treated with medication released from thin sheets of polymeric material implanted directly in the brain. In creating the materials that make these advances possible, scientists are gradually mastering an environment even more challenging than the ocean or outer space: the human body. □

THOMAS KIELY writes regularly about high technology and medical policy for Technology Review *and other magazines.*

PHOTOS: MARK C. ZIMMERMAN


145
GAS



BY DEBORAH L. BLEVISS

SAVING FUEL

We Have the Way . . . Do We Have the Will?

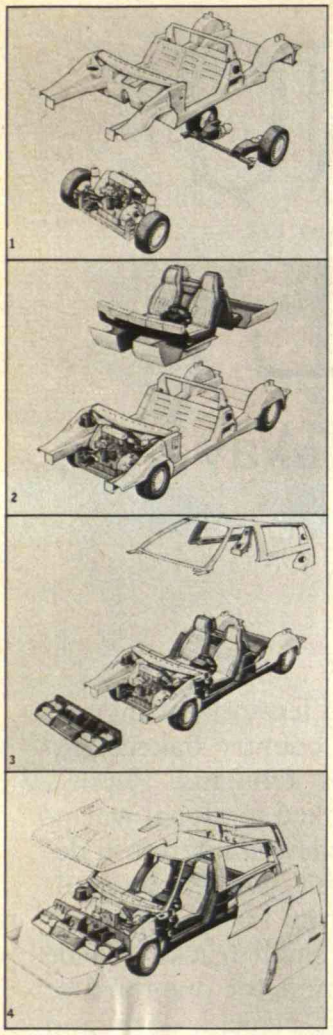
THE summer of 1988 was one few Americans will forget quickly. Most of the country baked, and many states suffered serious droughts. Reports that the unusual weather might be linked to global warming from gaseous emissions greatly renewed interest in decreasing carbon-dioxide emission levels. While an assault on the problem will have to come from many fronts, reducing fuel use in automobiles and small trucks will be critical. Transportation vehicles account for one-third of carbon-dioxide emissions, and "light" vehicles—cars and small trucks—are the biggest oil-users among them.

Over the past decade, automakers, led by European companies, have developed a bevy of highly efficient prototypes. Most of these vehicles get more than 60 miles per gallon in city traffic and 75 miles per gallon on highways, and many could be adapted for production well before the end of the century. Moreover, their technical advances could be used in production automobiles and small trucks without sacrificing safety, comfort, performance, low emissions levels, or affordability.

Consider Volvo's prototype LCP 2000, which gets 81

More fuel-efficient vehicles are within our grasp—and they could avert an economic and environmental crisis. But to put them on the market, government and industry must cooperate.

ILLUSTRATION: AMY WASSERMAN



The assembly of Volvo's prototype LCP 2000 is streamlined. 1) First, subassemblies that include the drivetrain, steering, and rear suspension are bolted onto an aluminum platform. 2) Then the interior is installed. 3) The roof and a subassembly that includes the headlights, horn, and radiator are attached next. 4) Finally body panels are added.

miles to the gallon on the highway and 63 in the city. This subcompact, finished in 1985, can seat four people, accelerate to 60 miles per hour in 11 seconds, and withstand crashes better than U.S. law requires. Also, the higher price of the car's materials and devices could be offset by the streamlined assembly that they make possible. Hence, engineers estimate the LCP 2000 could be manufactured at a cost comparable to today's average subcompact.

While Volvo's engineers stressed low emissions when designing the LCP 2000, the vehicle's emissions levels would still have to be decreased somewhat to satisfy the Environmental Protection Agency's standards. But promising new emission-control techniques mean that lowering levels would not be a daunting task. Rather, the major reason why Volvo has not produced the LCP 2000 lies in the company's concerns that consumers will not buy such a vehicle now. Their interest in fuel economy is very low.

Technology is no longer the limiting factor in producing fuel-efficient light vehicles. We could drive cars and small trucks that use far less fuel, and if we did, we would reduce the rate of global warming and diminish the threat of another oil crisis.

Despite these benefits, such vehicles are unlikely to come to market expeditiously. Today's low oil prices are promoting consumption, thereby encouraging people to buy larger and more powerful cars. So automakers—particularly those in the risk-averse U.S. industry—are unwilling to push aggressively ahead with the introduction of new fuel-efficient technologies.

Unfortunately, the particular reluctance of the U.S. automobile industry to energetically pursue fuel-efficient technologies could threaten its future. While automakers worldwide have slowed their introduction of fuel-efficient technologies, those abroad, particularly the Japanese, remain more committed to R&D in this area than American automakers. Detroit lags behind in such disparate areas of technology development as ceramic engines, innovative transmissions, and energy storage.

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This lag is occurring in an increasingly competitive domestic market. In 1985, Chrysler chairman Lee Iococca said he expected that by the middle of the next decade, the market share of cars produced in the United States by U.S. manufacturers would slip to 50 percent, down from 75 percent as recently as 1984. Even if the proportion is higher—as much as 60 percent, as more optimistic analysts anticipate—failure to keep pace in fuel-efficient technologies could render American automakers particularly vulnerable to their competition. Another oil crisis could make the situation even worse.

The benefits of pursuing fuel economy are clear, as are the perils of not doing so. But because market forces will do little to further that pursuit, it is up to national governments to assume the lead.

Losing Energy from the Start

There are many opportunities for reducing energy waste in today's cars and small trucks. The greatest reduction in fuel consumption can result from improving engine and transmission efficiency, and from decreasing the vehicle's weight, aerodynamic drag, and energy dissipated in braking. Fuel savings can also be made by improving the efficiency of accessories, and by reducing the frictional resistance between the tires and the road.

Since the 1970s automakers have disproportionately concentrated on increasing the efficiency in engines. Here, up to 80 percent of fuel energy can be lost to coolants and exhaust gases, as well as through radiation and convection to the surrounding air. The highest losses occur in a gasoline engine when it is operating at "part load"—when the power it provides is significantly less than the maximum it could produce at a given engine speed.

Engineers are pursuing several new developments in engine efficiency. For instance, they have long recognized that typical city driving results in needless waste in gasoline-powered cars because more fuel than necessary is burned. Using less fuel in the combustible fuel-air mixture has been out of the question in the past, because the mixture has burned too slowly and unreliably. But now better oxygen sensors and improved electronics have enabled automakers to solve the burning problem. In 1984 Toyota introduced an "ultra-lean-burn" engine in its Carina model, which is now sold in Europe. The engine improves fuel efficiency as much as 20 percent.

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Other sources of inefficiency in automatic transmissions are their limited gearing and tendency to lose energy when the fluid used in them moves, causing friction. The addition of more gears enables the engine to operate at its most efficient speed more of the time. Automatics are gradually evolving from three gears to four. And the use of special clutches that lock into place on the top gear can reduce friction caused by the fluid. This improves vehicles' fuel economy. Automakers are now trying to develop lock-up clutches for all gears.

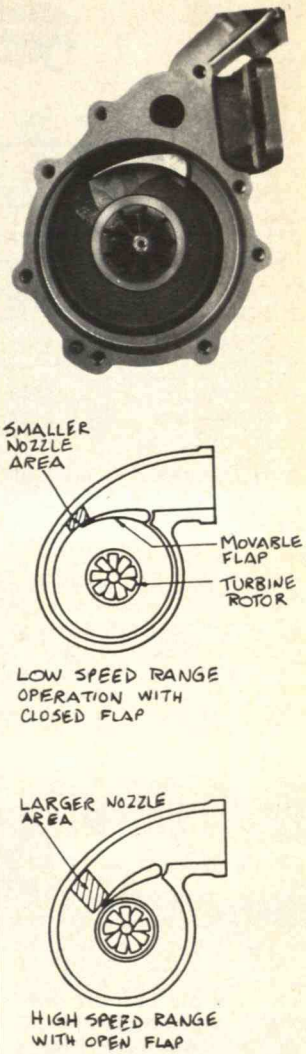
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Belt-driven CVTs are not new, but in the past they have been subject to control and endurance problems. Now electronic controls developed for conventional transmissions offer similar potential for belt-driven CVTs. And stronger materials are starting to provide better endurance. Subaru produces a long-lasting metal-and-plastic composite belt for the CVT on its Justy model that sells in Japan.

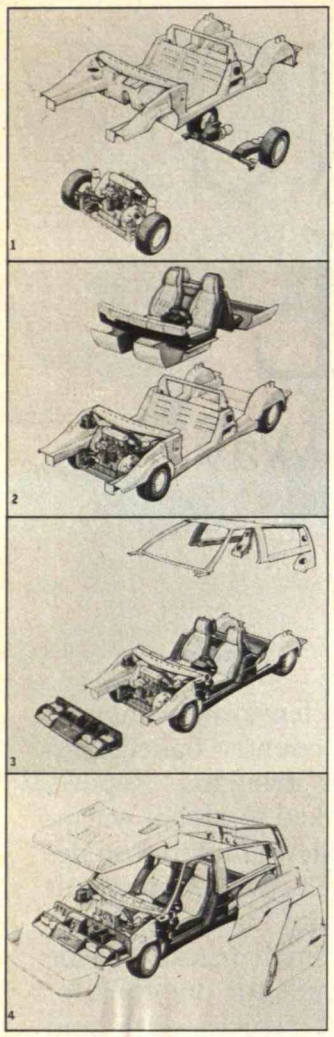
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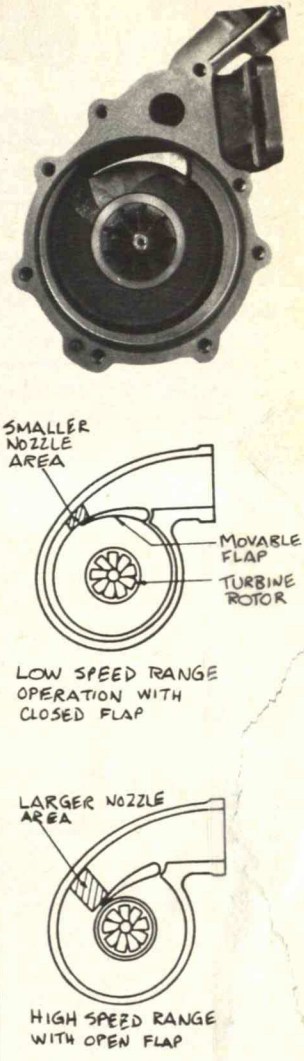
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FUEL-EFFICIENT PROTOTYPES







	General Motors	Ford	Volkswagen	Volkswagen	Volvo	Renault	Renault
Model	TPC	(no name)	Auto 2000	VW-E80	LCP 2000	EVE+	VESTA2
Fuel Economy	61 mpg city 74 mpg highway	57 mpg city 92 mpg highway	63 mpg city 71 mpg highway	74 mpg city 99 mpg highway	63 mpg city 81 mpg highway	63 mpg city 81 mpg highway	78 mpg city 107 mpg highway
Maximum Number of Passengers	2	5	5	4	4	5	4
Innovative Features	Aluminum body and engine	Advanced diesel engine	Advanced diesel engine High use of plastic and aluminum Improved aerodynamics Flywheel energy storage	Advanced diesel engine High use of plastic and aluminum Flywheel energy storage	Advanced diesel engine High use of magnesium Improved aerodynamics	Advanced diesel engine Improved aerodynamics	High use of light material Highly improved aerodynamics



Two people can lift the aluminum body that Audi and Alcoa are developing for Audi's 5000 series sedan.

of magnesium could have strength similar to that of 100 pounds of steel in a vehicle. While the alternative materials are more expensive, they remain cost-competitive: since they cut down on the number of parts needed in a vehicle, assembly costs are lower.

Of the alternative materials, plastics have been the most widely publicized. Plastic body panels are more resistant to dents and corrosion than steel. In 1983 vehicles with body panels made almost entirely of composite plastics started appearing. These include General Motors's Fiero, Honda's CRX, and Renault's Espace minivan, which is sold in the French market. While the Fiero was retired this year, industry analysts believe that GM plans to introduce other vehicles with such panels in the future.

More advanced than composite body panels are composite load-bearing parts. Volkswagen, Ford, General Motors, and Chrysler have taken the lead in developing a composite chassis.

Although U.S. manufacturers have assumed a prominent role in pursuing plastics applications, overseas competitors have done the most to make use of other new materials. In 1985 Nissan commercialized ceramic turbocharger blades. Since they are light and do not absorb much heat from engine exhaust gases, they transfer the energy to the compressor more quickly.

In addition, working with Aluminum Company of America (known as Alcoa), Audi is trying to produce for its 5000 series sedan an aluminum body that will be at least 10 percent lighter than today's steel body without costing appreciably more. And Volvo's LCP 2000 incorporates much magnesium, even in its engine block. The use of this material and others makes the vehicle very lightweight.

Another opportunity for improving fuel economy lies in reducing a vehicle's aerodynamic drag. On the highway, more than 60 percent of the energy supplied to a car's wheels is used to overcome aerodynamic drag. In recent years, cars and small trucks have evolved from a "boxy" look to a more streamlined profile. As a result, the drag coefficient of American cars has improved. In the late 1970s the average was 0.44. Today, Ford's Sable achieves one of the best drag coefficients for a domestically produced vehicle—0.3.

Dropping the drag coefficient much below 0.3 involves significant redesign, such as putting metallic skirts around wheels. The lead in aerodynamic research clearly belongs to Ford, which has developed an experimental vehicle, the Probe V, with a drag coefficient of 0.137. This drag coefficent is better than that of a U.S. F-15 fighter jet.

Running on Stored Energy

The greatest challenge in improving the energy efficiency of light vehicles could be re-

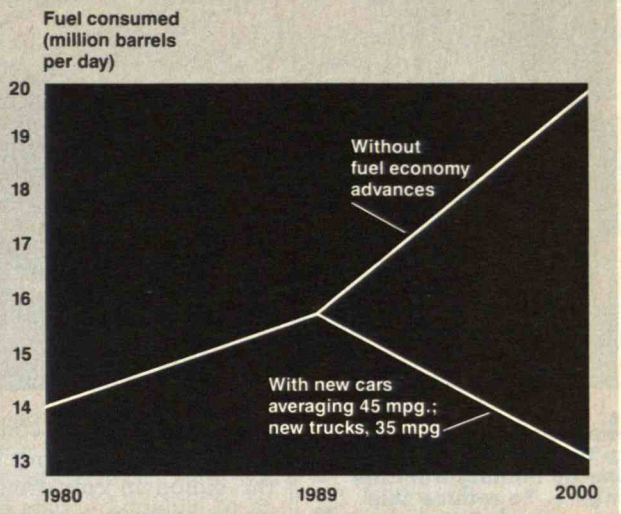
FUEL-EFFICIENT PROTOTYPES UNDER DEVELOPMENT





Peugeot	Peugeot	Toyota
VERA+	ECO 2000	AXV
55 mpg city 87 mpg highway	70 mpg city 77 mpg highway	89 mpg city 110 mpg highway
5	4	5
Advanced diesel engine High use of light material Improved aerodynamics	High use of light material Improved aerodynamics	Advanced diesel engine Continuously variable transmission High use of plastic and aluminum Improved aerodynamics

FUEL USE IN LIGHT VEHICLES



LEFT: Technological advances, some of which are enumerated here, make today's prototypes more efficient than ever. ABOVE: Worldwide consumption of fuel for light vehicles could actually drop in the next decade if new cars and small trucks take advantage of opportunities for increased efficiency.

ducing the energy loss associated with braking, because auto manufacturers—Volkswagen and Nissan excluded—have not studied this area extensively.

When production cars and small trucks slow down or idle today, the engine's power is largely unneeded and therefore lost to the coolant and exhaust gases. In VW's "glider automatic" prototype system, however, the excess engine energy is used to charge a flywheel. When sufficient energy has been stored there, the engine can be turned off and the flywheel used to run the accessories. The flywheel's energy also restarts the engine when more power is required. Volkswagen originally planned to introduce this device in its diesel Rabbit in the early 1980s, but dwindling consumer interest in fuel economy caused the company to postpone that event indefinitely. Nissan is now developing a device similar to VW's.

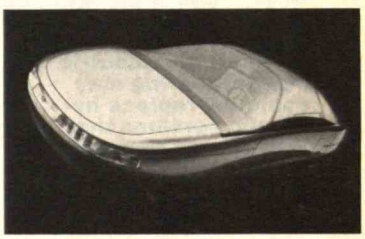
A more advanced energy-storage system was completed two years ago at the University of Wisconsin, with support from an unidentified Toyota affiliate. The system is set up so that the engine operates in its most efficient high-load mode all the time. When more power is delivered than required, the excess energy is stored in a flywheel much like VW's. Moreover, the system incorporates a CVT that essentially can be run backward during braking to recapture and store a large fraction of the wheels' kinetic energy in the flywheel. In addition to being used during deceleration and idling, the stored energy supplements the engine's power when an additional boost is required. Preliminary laboratory tests of this system indicate 50 percent fuel-economy improvement in city driving.

Work also continues on decreasing the energy losses associated with accessories and with tires' frictional resistance to rolling. Engineers are developing materials that cause less resistance to rolling, such as polyurethane, which can be injected into a tire mold while in liquid form. And researchers are developing more efficient air conditioners, alternators, electric power steering, and other accessories.

Seventy Miles to the Gallon

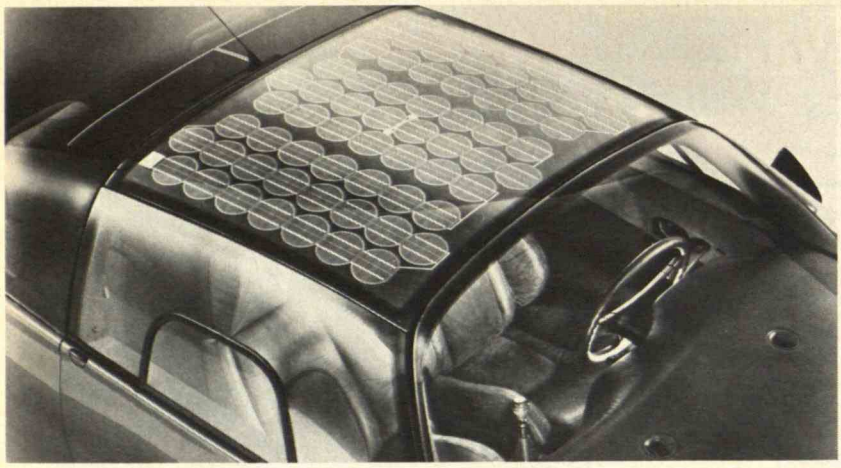
While several of the fuel-saving advances have been introduced in piecemeal fashion in recent years, no commercial vehicles have been produced with the aim of saving as much fuel as possible. Often automakers place fuel-efficiency devices in production vehicles for reasons other than fuel economy. (For example, Subaru introduced the CVT for passenger comfort, because the device doesn't cause the jerking characteristic of conventional automatic transmissions when they shift gears.) Yet prototypes loaded with fuel-efficient devices are in the wings. These vehicles offer a glimpse of what cars and small trucks could be like in the near future.

Volvo, Renault, Volkswagen, General Mo-





With its sleek lines and hooded wheels, Ford's Probe V has better aerodynamics than a U.S. F-15 fighter jet.



Accessories can use up to 10 percent of the energy coming from the engine. To reduce this figure, Saab-Scania has developed rooftop solar panels that run a ventilating fan. The panels, shown above on an experimental car, keep the passenger compartment cool when the vehicle is parked. Engineers are also trying to adapt clear window glazes that are used in buildings to cut down on solar heat. And electric power steering may someday replace hydraulic versions that lose energy through friction.

tors, and Ford have completed working prototypes that get about 60 or more miles to the gallon in city driving and 70 or more under highway conditions. The best vehicle developed, as far as gas mileage goes, is Renault's VESTA2, which gets 78 miles per gallon in urban traffic and 107 on highways. The car is tiny, seating only four people, but most of the innovations it incorporates could be scaled up to larger cars. The VESTA2 is very lightweight—1,047 pounds—and has an aerodynamic drag of only 0.186. Prior to the VESTA2, Renault completed the EVE+, a prototype powered by an advanced diesel engine. It seats up to five people and gets 63 miles to the gallon in city traffic and 81 miles on the highway.

Volkswagen has built two high-mileage prototypes, the most recent being the four-person VW-E80, which the company reportedly considered putting into production in the early 1980s. But when demand for fuel-efficient cars slackened, it was left on the shelf. The VW-E80 has the glider automatic flywheel energy-storage system and a supercharger—a power booster that captures exhaust energy much like a turbocharger. The car gets 74 miles per gallon in city traffic and 99 in highway conditions.

The two American prototypes are the Ford vehicle and General Motors's TPC—a two-person prototype with an aluminum body and engine—which gets 61 miles per gallon in city driving and 74 on the highway. The Ford car, whch gets 57 miles per gallon in urban traffic and 92 on the highway, has an advanced diesel engine placed in a five-seat, unidentified model. That model is now in production with another, less efficient engine.

Other automakers, including Peugeot and Toyota, are in the process of developing fuel-efficient prototypes. Toyota has the most ambitious program. It is trying to develop a car, the AXV, that can seat up to five people and get 89 miles to the gallon in urban traffic and 110 on the highway. The AXV is supposed to be developed with a CVT and extensive use of plastic and aluminum body parts.

Even the most innovative of these prototypes do not incorporate a number of technologies still being worked on, such as ceramic engines. Hence, by the end of the century light vehicles will probably be able to use even less fuel than today's prototypes suggest.

Apathetic Governments

While the public's love affair with large cars truly died after the oil crises, consumers have switched their loyalties away from fuel economy in recent years, moving from subcompacts to larger compact models. After all, when adjusted for inflation, today's low oil prices are actually less than they were before the first oil crunch in 1973. And within each size category, buyers are demanding more power. Demand has also increased for more air conditioning, automatic transmissions, and other fuel-consuming power options.

Exacerbating reduced consumer interest in fuel economy has been the lack of concern by national governments. In the 1970s, the United States set an important example by establishing laws to encourage fuel efficiency. Congress required manufacturers to provide consumers with information on the miles per gallon a vehicle could achieve. Federal legislators also imposed a "gas-guzzler" tax—ranging from $500 to $3,850—that buyers had to pay on the most fuel-inefficient cars, so as to discourage their purchase. Most important, Congress established regulations requiring manufacturers to improve light vehicles' average fuel efficiencies annually. By 1985, automakers' new car fleets were supposed to average at least 27.5 miles per gallon, and new small-truck fleets at least 21 miles per gallon. Following the U.S. lead, Japan and most European countries producing automobiles devised similar programs.

Unfortunately, the Reagan administration was hostile to fuel-economy programs. Efforts were continually made to rescind the fuel-economy regulations. These attacks were led by the departments of Transportation and Energy—and supported by the President's Commission on Regulatory Reform, which is chaired by Vice-President George Bush. Worse, no attention was paid to setting higher standards after 1985. Moreover, information programs were significantly cut back. And lax enforcement of the gas-guzzler tax enabled several manufacturers to define

loopholes allowing them to forego payment. Most notably, a technicality permitted car models that should have been assessed a gas-guzzler tax to be certified as having higher fuel economies than they actually did. Using this loophole, General Motors and Ford have not paid gas-guzzler taxes on most of their big cars.

The rest of the world has followed suit in backing away from fuel-economy measures. No country participating in the original programs has updated them.

Lacking either a consumer or governmental push for fuel efficiency, it is not surprising that light-vehicle manufacturers are not aggressively trying to commercialize fuel-saving technologies. Introducing a new technology, after all, is a gamble. The consumer might dislike it, or the technology might not work properly; the resulting poor publicity would inevitably affect sales.

The reluctance to introduce new technologies is particularly characteristic of the American industry. U.S. automakers are more likely to let a competitor bring a technology to market before they introduce it. Electronic transmissions, multiple-valve engines, and anti-lock brakes are but a few examples of technologies in which domestic producers have consciously allowed their competitors to beat them to market. It is not surprising, then, that American industry noticeably lags its competition in developing fuel-efficient technologies.

The Perils of Doing Nothing

The failure to pursue fuel-economy improvements aggressively carries significant risk. Oil production in industrialized countries—particularly the United States—is expected to decline sharply in the next decade. At the same time, traditionally friendly suppliers such as Mexico and Indonesia will probably reduce their oil exports because of increased domestic demand and decreased reserves. These trends point to an increased reliance on Middle Eastern oil—which accounts for two-thirds of the world's known oil reserves—and a growing likelihood of a new oil crisis in the 1990s. With the transportation sector accounting for nearly two-thirds of oil use in the United States, cars and small trucks stand as both the crux of the problem and the root of the cure for future oil woes.

The renewed growth in oil demand also does not bode well for controlling the rate of global warming. Oil accounted for 45 percent of global carbon-dioxide emissions in 1985. The inability to improve fuel economy will counteract any global efforts to reduce these emissions.

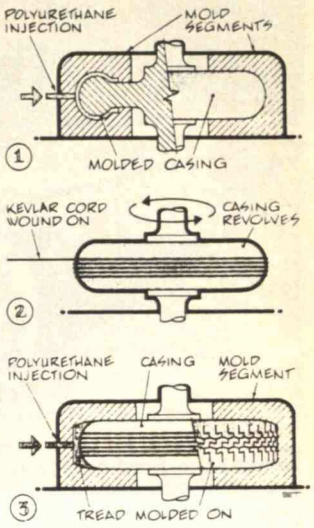
Added to such worries will be the economic harm that the domestic auto industry could suffer if it does not start producing more fuel-efficient vehicles. Overseas competitors are continuing to eat into the U.S. market share. In adjusting to the reduced market share, U.S. manufacturers are expected to cede their smaller model lines in favor of the larger models that face fewer competitive pressures. Domestic automakers have never felt comfortable with the smaller cars and trucks, and competition will be fiercer here.

This tactic will lead to disarray among American automakers if a new oil crisis arises. Without a small-car base, they will lack the flexibility to respond quickly to renewed consumer demand for fuel efficiency. Small cars need not be the only means to respond to demands for fuel economy, but with domestic producers' lag in fuel-efficiency R&D, overseas competitors will have an advantage. The result can only be another crisis for the U.S. auto industry.

Government Action Required

Clearly, neither the United States nor the world at large can afford to neglect making more fuel-efficient light vehicles. But without an impetus from government, car and small-truck manufacturers are unlikely to change their strategies in time. Most of the fuel-efficient prototypes have resulted from partnerships between companies and national governments that recognized the competitive advantage of developing new technologies. Vehicles built by Volkswagen, Renault, Peugeot, Fiat, and, of course, the government-owned British Leyland evolved under these circumstances. The United States has been a valuable role model in fuel-conservation efforts in the past, and it is entirely appropriate—indeed critical—for this country to exercise that leadership again. Such leadership needs to be exerted in several areas.

To start, the U.S. Department of Energy's $50 million federal R&D transportation-efficiency program needs revamping. Traditionally, this program has focused on long-term research such as electric vehicles and gas turbines. The commercial fruits of these studies would be harvested well into the next century, if ever. At the same time, the U.S. light vehicle industry has concentrated on research applicable to the next model lines. Missing in these endeavors has been "medium-term" research—such as on energy-storage systems



Tires lose less energy if they're less resistant to rolling. In one improved tire, polyurethane is injected into a casing mold. Next the mold is removed and Kevlar fiber is wound around the casing. Finally the mold is replaced and more polyurethane is injected to form the tread.

DIAGRAM: *POPULAR SCIENCE*



Could the Ford brothers—William, Benson, and Henry—have imagined today's possibilities for fuel efficiency when they marketed this Edsel convertible in 1957?

and ceramic engines—that would be applicable into the beginning of the next century. The federal program must increasingly concentrate on this area. At the least the Department of Energy should redirect some money from its existing fuel-efficiency R&D program. Preferably the government should allocate more funds.

Federal R&D programs will be useless without industry's participation. In addition to the automakers and their suppliers, the small innovative engineering companies that have sprung up around automotive centers like Detroit must be involved (such as Adiabatics in Indiana, which has worked on ceramic engines). A revamped federal program must incorporate all of these companies, probably in an arrangement in which they share the costs of the research. This is how prototype development has been handled in Europe. It has given the companies a stake in the success of the research.

The second necessary activity for the U.S. government—reinvigorating consumer interest in fuel economy—must start with price signals. Consumers will not be interested in fuel economy unless prices at the gas pump increase. Higher prices could come from a gasoline tax or an oil-import fee. Needless to say, care must be taken to protect those who would be unduly harmed by such an increase. A rebate for lower-income households is one option.

In addition, the more the message of fuel economy can be imbedded in a vehicle's price, the more likely consumers will be to act. They respond more directly to the price of a vehicle than to that of fuel. Since 1986 the threshold below which the gas-guzzler tax was imposed has been frozen at 22.5 miles per gallon. Raising this fuel-economy level on a continual basis would emphasize to consumers the undesirability of purchasing even moderate gas guzzlers. Finally, while consumers might be penalized when they buy gas guzzlers, perhaps they should be rewarded for buying gas "sippers." The Carter administration proposed a rebate for such vehicles, but it was not enacted at the time because of fears that the rebates would benefit foreign automakers. With foreign manufacturers now producing cars in the United States, the concern has dissipated.

Stimulating manufacturers to sell fuel-efficient models will probably run into the most political opposition. The antipathy of the Reagan administration to past fuel-economy controls—known as CAFE standards (for Corporate Average Fuel Economy)—has encouraged the automotive industry to seek relief from regulations, often through questionable administrative means. The time has come, however, to recognize the values as well as the problems of the CAFE regulations, and move on. An editorial by the trade publication *Automotive News* explains why: "If anything, CAFE standards have made the domestic industry more competitive with carmakers in Europe and Asia—for they required the domestic industry to change quickly, albeit kicking and screaming."

New fuel-economy regulations would have to correct some of the problems with the past standards. For example, the old standards required the same level of average fuel economy for each company, regardless of whether it made both small and large cars, or just one line of vehicles. This structure gave Japanese companies, which primarily produce small cars, an unfair advantage over American automakers. Requiring automakers to meet the same *percentage* of average fuel-economy improvements would solve the problem.

This change should be adopted in such a way that, at the very least, within 10 years regulations achieve new national car fleets that average 45 miles per gallon, and new small-truck fleets, 35 miles per gallon. Were these levels reached worldwide, total fuel use by light vehicles could drop below 1980 levels by the year 2000. That is based on projections that the number of cars worldwide will grow by over 60 percent to more than 500 million.

Government policymakers, particularly Americans, are at a critical decision point. They can choose to ignore the signs warning of possible global warming, a third major oil crisis, and—for the United States—threats to the future viability of the domestic car and light-truck industry. Or they can exert the leadership they displayed in the last decade and guide car owners and automakers along a path leading to more fuel-efficient light vehicles. □

PHOTO: BETTMANN/UPI

A view from Washington

ELECTRICITY—ACUTE NEED FOR NEW SUPPLY

Long after the searing summer heat has passed, 1988 will be remembered as the year many of America's utilities recorded electricity demand they hadn't expected until the 1990s. That may make 1988 the year that America awakens to the pressing need to build new electric generating capacity.

Hot weather is only part of the story. Even without the record summer heat, the U.S. is quickly approaching the time when electric utilities will not be able to meet normal growth in electricity demand. In some regions, they already can't.

Higher Than Forecast

Since 1982, when the U.S. economy emerged from recession, growth in electricity sales has been much higher than most experts had forecast. If this rate of growth persists—and, without a recession, it will—electricity demand will overtake reliable, cost-effective supply as early as 1990.

Electricity use is growing faster than expected because the U.S. economy is becoming more electricity-intensive, continuing a long-term trend. America's use of nonelectric forms of energy has declined about 10 percent since the 1973 Arab oil embargo, but electricity use has increased about 50 percent, with almost all the increase provided by coal and nuclear energy. Electric power has been the engine driving our economic growth. The 50 percent increase in electric use since 1973 has given us about a 45 percent increase in GNP. Electrification also increases our energy efficiency, reducing the amount of energy required per unit of GNP.

The Oil Problem

New baseload electric power plants can also help avert another looming crisis—this nation's growing addiction to imported oil. This dependence is a direct threat to our national security and worsens our trade deficit.

The problem with oil is that most of the world's supply belongs to other countries. The U.S. has less than 5 percent of the world's oil reserves and our production is declining, yet we use more than 25 percent of the world's production and our consumption is rising. America's oil imports are rising, rapidly approaching 50 percent of all the oil we use. Last year, the U.S. paid about $40 billion for imported oil, one-fourth of our record trade deficit.

The solution to our growing foreign oil dependence is the same today as it was after the 1973–74 oil embargo—to use energy more efficiently and to turn to more electricity generated from fuels like nuclear energy and coal that America has in abundance.

The Benefits of Nuclear Energy

Nuclear energy is now America's second largest source of electricity, after coal. We have 109 nuclear electric plants licensed to operate in 33 states. Since 1973, our nuclear electric plants have helped us cut the use of foreign oil by 3½ billion barrels and reduced our payments to foreign oil producers by $105 billion. And these plants have operated only for about one-quarter of their useful lives, so their benefits—already large—will continue to grow.

Nuclear energy also has environmental benefits and does not contribute to the "greenhouse effect." Since 1973, the 412 nuclear electric plants around the world have cut the world's coal use by over 2.5 billion tons and its oil use by about 16 billion barrels, with resulting reductions in "greenhouse" gases.

Despite our growing need, regulatory, political and financial uncertainties prevent electric utilities from planning the new baseload power plants—coal or nuclear—that are required. Our economic growth and national security depend on removing those obstacles.

Otherwise, electric utilities will be forced to turn back to oil-fired plants that were relegated to limited service by the coal and nuclear electric plants built over the last 15 years. This means more expensive electricity and even greater dependence on imported oil from the unstable Middle East.

Nuclear electric power plants, by themselves, cannot solve the tensions in the Persian Gulf or our other oil-related problems. But they helped America and the rest of the world overcome the energy crises of the 1970s. They are fueling our economic growth. And they can help cushion us against economic and military shocks in the 1990s and beyond.



Harold B. Finger
President and Chief Executive Officer
U.S. Council For Energy Awareness

A View From Washington is a series of essays sponsored by corporations and associations. The views expressed do not necessarily reflect those of the magazine.

The Future of East-West Industrial Cooperation

BY JOHN E. PARSONS

UNDER the "New Thinking" ushered in by Mikhail Gorbachev, the Soviets are rapidly warming up to the idea of economic cooperation with Western corporations. Reactions in the United States and Europe range from ebullient to cynical. At the one extreme are those who herald the thaw as an important new opportunity for Westerners. At the other extreme are those who recall the detente of the 1970s, in which initial euphoria over East-West trade was dashed by the actual experience of doing business with Soviet enterprises.

Both views contain elements of truth. Investors and diplomats who greet the Soviet initiatives enthusiastically are correct that the substance of Soviet thinking has indeed changed. At the same time, the Western idea of foreign investment and the Soviet concept of

To benefit from Soviet economic reforms, we must understand the socialist view of East-West trade.

ILLUSTRATIONS: LES KANTUREK


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a planned economy are still in many ways contradictory. However, both reactions lack a critical reflection on how Western investment would be incorporated into a planned economy. If we fancy that businesses might be allowed to operate in the Soviet Union the same way as in the United States, then we will fulfill the cynics' prediction of failure.

Most Western observers believe the New Thinking recognizes that the socialist model has failed, that national economic planning has failed. In *Foreign Affairs,* Marshall Goldman presented such a view: "If Gorbachev is to solve the Soviet Union's economic shortcomings, he must impose on the country a structural economic reform. . . . The implications of such a far-reaching reform are potentially very disruptive. For a starter, most proposals involve the abandonment of central planning." Borrowing Marx's wording, Goldman says that "the central plan has become a fetter."

In this view, serious reform is equated with abandoning socialist principles. The debate among Western economists about the depth of the reform becomes a debate about how seriously socialist economists and politicians are questioning socialist ideology. These Westerners who expect much of the reforms believe that the ideology has been abandoned. Those who know that the ideology has not been abandoned conclude that no serious reform is possible.

Both assessments are fundamentally mistaken. The New Thinking in the Soviet Union does represent a basic questioning of socialist dogma, but the questioning is occurring within the framework of Marxism-Leninism. While the New Thinking is open to interactions between capitalist and socialist institutions, it stands firmly by the socialist opposition to capitalism as a whole. As Vadim Medvedyev, a member of the Central Committee of the Soviet Communist Party, has asked, "How is one to decide on the forms of interaction under which socialism would be most actively involved in the international division of labor, while retaining its own socialist origins and intensifying the influence of its humanistic ideals on the world?"

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What's New in the New Thinking

Contrary to the prevailing Western opinion, proponents of the New Thinking believe that history has confirmed two important socialist tenets. First, planning can manage social and economic development in a manner that broadly improves economic well-being and avoids some economic crises, such as unemployment, uneven development, and race and class divisions. Erich Honecker, the general secretary of East Germany's ruling party, declared in 1986, "There are but few countries in the world that have made comparably solid and dynamic economic progress over such a long timespan and have been able to constantly match this with improvements in the social sector." The Soviet economist Stanislav Menshikov, in a dialogue with John Kenneth Galbraith, put the perspective this way: "For many nations, socialism has become the only road to fast economic development, sovereignty, independence. Socialism has proved such advantages as non-cyclical development of the economy, full employment and elimination of compulsory unemployment, [and] vast expansion of social security and public services, including free medical care, free education, low-cost housing, pensions for everybody, [and] wide access to recreation facilities."

Moreover, the socialist states believe history has confirmed their basic commitment to the sovereignty of each national economy, as well as to that of the socialist community as a unit. As one element of sovereignty, they long ago rejected the notion that the prospects of a nation are identical with the profitability of corporations operating internationally.

If socialists continue to adhere to these principles, what then is "new" in their thinking? It is the frank recognition of failures as well as successes: the New Thinking results from the confrontation of Marxism with the experiences of the last four decades. It contains a fundamentally new view of the relationship of socialist economies to each other and to the capitalist world.

In the first place, technological development has made industrial production and a host of related economic problems international. "Economic security is secured less than ever through withdrawal from the international division of labor," writes East German economist Horst Heininger.

Moreover, Heininger and his colleagues are attempting to account for the relatively stable eco-

nomic growth in the capitalist world since World War II. An important factor in this success has been Western development of international institutions that promote multilateral trade and financial flows. Says Heininger, "In international organizations such as the International Monetary Fund, the World Bank, and the General Agreement on Trade and Tariffs (GATT), the capitalist industrial countries possess the deciding influence."

At the same time, the dogmatic Marxist rejection of all Western economic arrangements has given way to a more sophisticated differentiation among these forms. Where Western analysts see a choice between a market or a planned economy, socialist economists see their task as giving the market a role within the plan. Where Western analysts see an abandonment of central planning, socialist politicians see a maturation of planning. The latter continue to assert that capitalism is essentially exploitive, but they no longer automatically apply this characterization to every aspect of a capitalist economy.



The Soviets have decided that foreign investment is essential for technological progress and inclusion in the modern world economy.

In particular, the New Thinking about the benefits of and legitimate forms for Western investment in socialist nations is real and deep. The Soviets have confronted and rejected their old prejudices against Western firms investing in socialist economies. Foreign investment, they have decided, is essential for technological advancement and for Soviet inclusion in the modern world economy. But at the same time, they believe that such investment must be carefully controlled. Otherwise, it will undermine the welfare of the Soviet people and bring unemployment, recessions, and indebtedness.

Exactly how foreign investment can be encouraged, regulated, and integrated into planning is a question without a precise answer. We in the West have an opportunity to help provide the answer. The experience gained from the increased East-West trade and industrial cooperation that accompanied detente in the late 1960s and early 1970s—and the disappointments that followed—can serve in this process.

Looking Back

In the beginnings of detente, the opportunities for trade and the need for industrial exchanges forced the socialist states to entertain new forms of cooperation. One of the key forms was the industrial compensation agreement. The socialist firm would purchase large-scale capital equipment—whole plants and machinery—from a Western company. That firm would in turn make a long-term commitment to purchase at a fixed price the products to be manufactured or processed with the equipment. Between 1969 and 1980, compensation contracts accounted for the delivery of $30.5 billion in equipment from the West to Eastern European countries and the Soviet Union.

While arrangements similar in form to a compensation contract have existed for centuries, it appeared formally with an agreement negotiated in 1969 to build a natural-gas pipeline from the Soviet Union to Austria. Comparable types of contracts also help finance large-scale capital investment projects within the United States. Internationally, compensation-like agreements also finance more than East-West trade. For example, in 1970 the Boston-based Cabot Corp. contracted to import liquefied natural gas from Algeria for 20 years. These contracts were part of the financing to construct facilities in Algeria.

One of a variety of arrangements developed to



facilitate East-West trade, compensation agreements create a set of mutual obligations between the parties. Because the equipment seller is obligated to purchase and market a portion of the products manufactured, it has a long-term stake in the project. At the other end, the plant operator's long-term commitment to a fixed price provides a strong incentive for efficient operations.

The compensation contract is often the contract of choice even between two capitalist firms. The commitment of a compensation agreement benefits both sides by making cooperation possible. To assure each other of the stability of a deal, capitalist businesses often enter into long-term commitments to purchase products. For example, Sun Microsystems needed an advanced microprocessor for its next generation of computers, and it wanted to convince its supplier, Fujitsu, to invest in the costly design process and the needed equipment. Sun guaranteed to purchase its microprocessors from Fujitsu, and it shared proprietary information on semiconductor design with the supplier.

Under compensation agreements during the mid-1970s, the Dutch engineering firm Hoogovens Ijmuiden BV helped Polish companies construct steel structures for developing and expanding coal mines. Hoogovens and several other Dutch steelmakers purchased the coal from these mines. Similarly, under a 1984 agreement with East Germany, Volkswagen sold a production line for automobile engines, and since then has purchased a large fraction of the East German engines for its Golf, Polo, and Jetta automobiles.

This kind of industrial cooperation was integrative: it involved a chain of production leading from raw materials to intermediary or finished goods. The tight coordination required at each stage crossed the boundary between socialist planning and capitalist free markets.

Of course, de facto coordination arises whenever capitalist and socialist enterprises engage in large-scale exchanges of raw materials, consumer goods, or light manufactured goods. However, the scope of the industrial compensation agreements required a qualitatively greater degree of cooperation and integration than did the simple repeated sales of goods that made up earlier East-West trade.

Socialist countries experimented with a variety of forms of economic cooperation with the West during the 1970s, including joint ventures and licensing and royalty agreements. But the industrial compensation agreement was perhaps the only new and significant form of financing and organizing large-scale industrial cooperation that *every* socialist country advocated. And in its degree of centrality, acceptance, and institutionalization, it was unmatched by any other major form.

The New Thinking will substantially increase East-West trade only if we accept the differences between the two systems.

Learning from Experience

The experiments with compensation agreements and other forms of East-West industrial compensations highlighted one essential problem: East and West manage and regulate economies in inherently different ways. This contrast immediately becomes apparent in the execution of *any* East-West industrial cooperation, and it did in the case of compensation agreements.

The best-known conflict arose over a series of compensation agreements that led to a large flow of chemicals from Western-built factories in Eastern

Europe. For example, the British chemical company ICI agreed to help build a methanol plant in the Soviet Union. For the first ten years of its operation beginning in 1981, 350,000 tons of methanol per year have been sold to ICI to supply its synthetic protein and gasohol ventures.

East and West entered into the compensation contracts with a reasonable anticipation that Western buyers would need the contracted supplies of chemicals. The socialist countries depended on these agreements as part of their long-term effort to modernize and restructure their chemical industry.

As it turned out, Western Europe was at times oversupplied with the chemicals, forcing Western companies to shut down plants and lay off workers. Many people in the West, including both union officers and competing industry representatives, therefore advocated government intervention to cancel the obligations to purchase the socialist products, denouncing the initial decisions to set up the compensation agreements. Most often, the contracts continued, although an arrangement for ammonia sales with the United States was cancelled.

It is possible to play down this debate as the inevitable wrangling that follows a disappointing project on which any two parties—socialist or capitalist—embark. "Caveat emptor" is certainly an important principle. When Western suppliers of capital equipment agreed to buy chemicals, they knew what obligation they were entering into and what that would mean if demand for chemicals weakened.

But dismissing the controversy in this way would overlook the larger problem. Firms in socialist countries will continue to seek greater levels of commitment than their capitalist counterparts are used to offering—and greater levels than some Western firms can reasonably offer, given an economic system that expects the individual firm to weather adverse conditions. Socialist firms will also be less willing to accept unemployment as the cost of declining demand.

Although the conflict appeared with compensation agreements, they were merely the messenger that revealed the bad news. We must anticipate similar obstacles to *any* form of large-scale industrial cooperation—including the currently fashionable "joint ventures"—between the socialist and the capitalist world.

The problems are on a par with those of creating an international capitalist economy while simultaneously maintaining different monetary and fiscal policies. The fact that the characters of the political and economic systems involved in East-West trade are so different exacerbates the situation.

Misinterpreting Compensation Agreements

Whether the New Thinking will substantially increase East-West trade and cooperation depends largely on the West's willingness to accept these differences as it responds to overtures from socialist states. Are we prepared to entertain special forms and institutions that do not obviously correspond to our own notions of proper business relations? Are we prepared to respond to the interests of socialist nations as we negotiate the legal and institutional environment for foreign investment?

Western views of compensation contracts shows that some New Thinking would profit the West. Our economists and policy makers have been hostage to the ideological misconceptions and narrowness with which they approach socialism. It is ironic that a contract that Western economics would view as perfectly rational in the abstract is dismissed simply because it is the focus of East-West trade.

The first common misconception is that a compensation agreement is an inherently cumbersome way to finance trade and industrial cooperation, one that conforms to the inefficiency of planning. Bruce Kogut, an economist who specializes in international trade, writes that "chronic weaknesses regarding the capacity of the centrally planned economy . . . [promote] the use of these contracts."

A second assumption is that the flow of benefits from compensation agreements is one-way—that they allow socialist countries to push low-quality goods onto Western markets, use Western management to improve quality, or shift marketing risks to Western firms. According to Jacques de Miramon, an officer in the Organization for Economic Cooperation and Development (OECD), "Above all, the object of countertrade is to make up for the lack of international competitiveness of the products which the East-European countries wish to export and the lack of dynamism of their managers."

Third, it is said that socialist countries choose compensation contracts to save scarce foreign exchange when purchasing large-scale capital equipment. In the *Harvard Business Review,* David Yoffe asserts that "many countries insist on barter ar-



rangements simply because they are broke. . . . With [countertrade], they can 'hide' foreign exchange and continue to import."

Finally, Westerners assert that socialist countries are attempting to balance their trade with the Western partners. Secretary of State George Shultz, at a meeting of the ministers of the OECD nations, charged, "The Eastern countries, facing lagging exports, are attempting to pay for an ever-larger share of their imports by compensation deals and barter arrangements."

None of these views recognizes the important and valuable function that a well-written compensation agreement serves. They all reflect instead the prejudicial Western idea that nearly every legal, administrative, or policy device used by a socialist firm or economy is irrational.

The Soviets are willing to consider new economic forms because they recognize that the East-West struggle must be conducted in a world where cooperation is possible.

The unfortunate result has been that Western governments have discouraged and obstructed compensation contracts and other similar paths for expanding East-West industrial cooperation. According to Shultz, "These anti-competitive practices have a great potential to do harm to all our countries. . . . We all have an interest in having these inefficient practices monitored."

Similarly, a U.S. trade official told the OECD ministers, "The Treasury is flatly opposed to countertrade." And the OECD report on countertrade practices concluded, "They entail unnecessary complications in the transaction process and introduce additional trade risks for Western firms that are not countered by any significant advantage."

In 1984, the Western industrial countries even tried to use GATT negotiations to ban compensation contracts and other forms of countertrade. But several developing countries, who wanted to retain these means for trading, blocked the attempts.

Although Western views of socialist countertrade policies in general and compensation agreements in particular do contain a kernel of truth, it is wrapped in a bundle of false arguments. The socialist promotion of industrial cooperation has stemmed from three factors that converged during the detente years. First, East and West had a mutual interest in large-scale industrial cooperation at that time, which demanded complex forms of coordinated operations. Second, compensation contracts are especially appropriate for projects focused on natural resources, which both parties desired.

Third and most important, as Western authors have stressed, the coordination and long-term commitment inherent in compensation agreements fit the reigning ideology of socialist planning. Such contracts accommodated the first two conditions without requiring too serious an adaptation of ideological structures.

New Forms of Economic Cooperation

If industrial projects between the two systems are to increase, both parties must adapt to some of the ways the other regulates and promotes its economy. The Eastern nations recognize that the modus operandi cannot be what they had hoped as recently as 10 years ago. In the New Thinking, they have accepted the need to incorporate many features basic to the capitalist financial system. For example, they have established convertible currencies and separate accounting for the profits of a firm that deals with the West. But we Westerners are fooling ourselves to expect that it will be a compromise on our terms alone. We will be

fooling ourselves if we think the terms of East-West industrial cooperation will be nestled within the framework of a capitalist economy.

We will, of course, legitimately attempt to assert our own notion of the proper regulatory environment. So long as we recognize that we are negotiating—and we do not insist that we are championing the only efficient and sensible form of agreement—discussions can proceed fruitfully and rationally.

While the socialist states have yet to show that they understand the logic behind various capitalist institutions, they have a stated commitment to learning, and changes are already visible. For example, Dieter Klein, dean of the school of social sciences at East Berlin's Humboldt University, has called for research to find "a variant of state-monopoly capitalism that is capable of peace and oriented to at least partial solution of other global problems."

This willingness to consider new economic forms derives from a recognition that something must be done, that the struggle between the two social systems must be conducted in a world that admits cooperation. The East has not incorporated the rational core of capitalist forms into an orthodox Marxist analysis. But there is a consensus that the forms are not the essential problem, that they do not conflict with Marxism, even its orthodox version.

Westerners must be equally frank with themselves. Will we repeat the pattern of the 1970s, approaching the new openness of socialist nations as an opportunity to push the narrow view that economic cooperation means direct investment by multinationals? Or will we be prepared to abandon our prejudices and analyze the ingredients for cooperation more objectively?

If we do not learn from the limitations that revealed themselves in the 1970s, our hopes for fruitful East-West cooperation will once again be frustrated. We will be in a poor position to design a set of feasible goals that serve our own interests, let alone discover a strategy to meet them. New Thinking is demanded in the West as well. □

DAEDALUS

HOW TECHNOLOGY RECREATES A LEGEND



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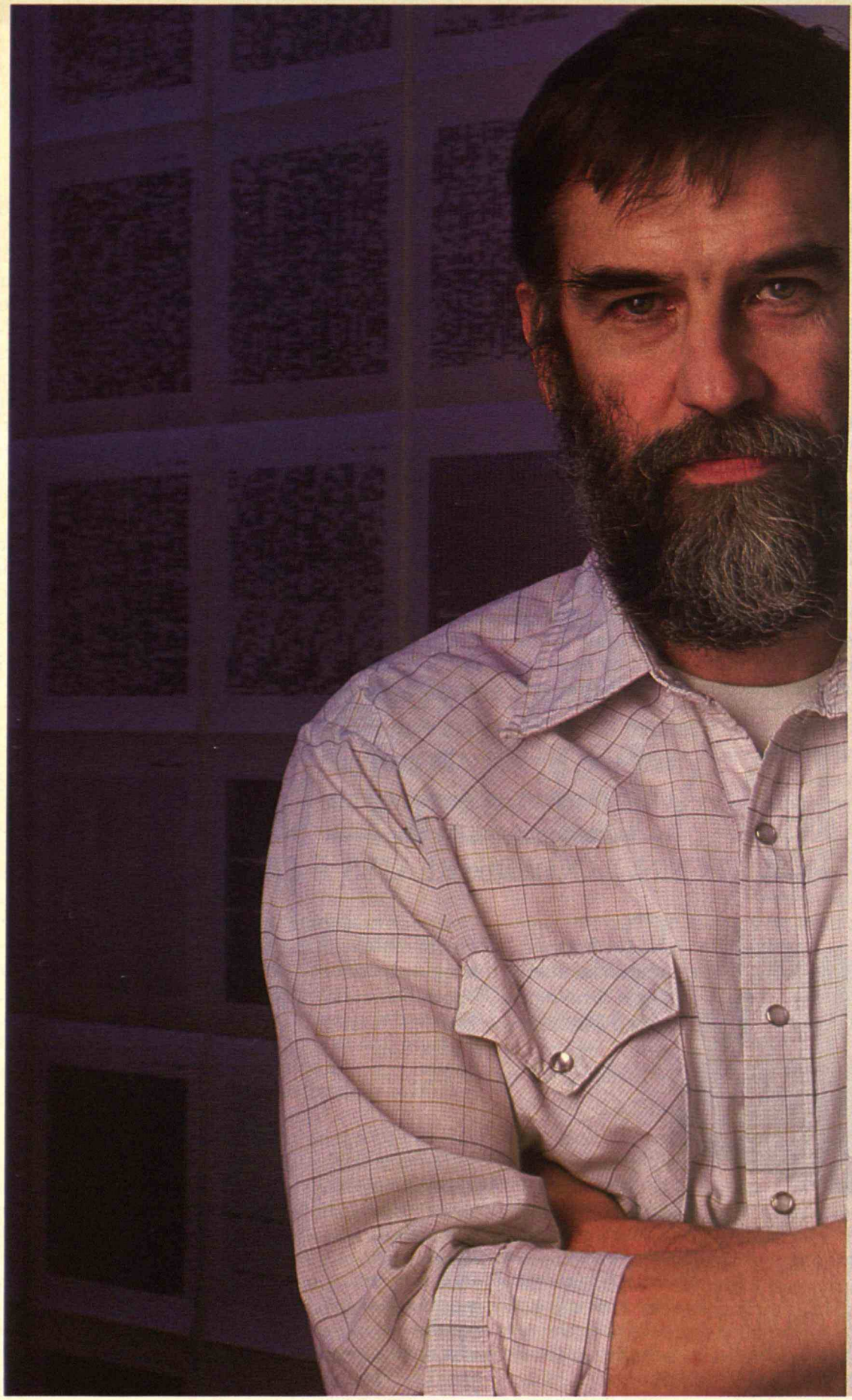
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The Art of a New Machine

OR

Confessions of a computer artist

BY HUBERT HOHN

I BECAME a computer artist entirely by accident. In 1982, when I was teaching photography at the Banff School of Fine Arts in Alberta, a friend needed some cash in a hurry. He ended up with my savings, and I ended up with his washer and dryer and his Apple II computer. I was pretty clear about what to do with the washer and dryer, but the Apple provoked me for a long time. I had once worked as a programmer in administrative data processing for a university, and the computer inspired memories of cost analysis and the student master file. I thought, "Why would anyone want to do that at home?" The idea of connecting a computer to my lifelong interest in art was unimaginable.

A year or so later, someone on the other end of the country made the connection for me. I got a call from Halifax saying, "We're having a conference in three months called 'Art and Technology: Defining the Issues' and we heard that you do computer art. Would you like to be in a group exhibition for the conference?" The caller was obviously misinformed, but being a naively optimistic sort, I said "Sure." I was certain that in three months' time, anyone could invent a work of art in any medium. I began trying to imagine what a work of art made with an Apple might be like. During that entire period, the idea of making

PHOTO: SAM OGDEN

> "MY WORK EXPLORES A COMPUTER AESTHETIC BASED ON THE UNIQUE PROPERTIES OF THE MACHINE."



COMPUTED SIMULATION, 1988; BRIAN WILLIAMS

a picture with it never crossed my mind.

Nor did any other ideas.

About a week before I was due to hang my yet nonexistent work, I phoned to find out how much wall space I had, so I would know what I was up against. Was it 18 inches or two feet? The answer: an entire room. Aesthetic theorizing went out the window. The issue was now size and size alone. I had to make big art. I had a printer to which the computer was happy to send data day and night, and I had no choice but to build an aesthetic on this simple fact.

The first thing I did was dump the entire memory of the computer to the printer. That filled a wall. Then I dumped as much as I could of the various codes it takes to make a graphic image: source code, object code, language interpreter, graphics buffer data, printer drivers, machine code assembler, etc. That filled another wall. I also did a piece on repetition, a wall filled with dozens of identical digital "originals" generated by a simple program. (For the fourth wall, I bought a copy of every art magazine and technology magazine I could find and placed them on a long table, calling it *Art and Technology: Defining the Issues.*)

What was forced upon me that week was a basis for making computer art that exploited the machine's ability to count, to repeat its operations indefinitely, to generate and move data, to stay up all night without getting tired. Ever since, my work has questioned the nature of the machine and grown out of its fundamental operations and processes, its unique possibilities, its relationship to the history of ideas, its relationship to society and to me.

The Horseless Carriage Syndrome

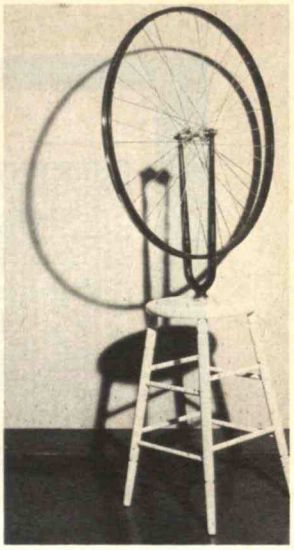
I may have been uncertain about what a work of computer art might be, but I was pretty sure what it was not. I had spent much of my life in the field of photography and was wary of falling into the same trap with the computer as nineteenth-century artists had fallen into with the camera. For a long time after photography was invented, there were photographers who looked at their works and said, "They're sort of like paintings; let's see if we can make them look even *more* like paintings." They imitated the look and content of paintings—etching fake brush strokes into the negative with knives and chemistry—to disguise the fact that photographs were made with cameras.

With almost any radically new technology, there is a strong impulse to emulate previous technologies rather than confront the new one on its own terms: the automobile was introduced as a horseless carriage, early films imitated theater, broadcast television began as radio with pictures. It may be a positive tendency, a way of maintaining cultural continuity; or it may be a naive tendency, an inability to use historical evidence to avoid silliness. In any case, I used to wonder what I might have done had I been there in 1826 when Nicéphore Niépce photographed the view from his window. Would I have seen what photography could become, or would I have copied the paintings of Corot? Faced with the prospect of using a computer to make art, I thought: "Now's

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TWO WAYS OF LIFE, *1857; OSCAR REJLANDER*



BICYCLE WHEEL, *1913*
MARCEL DUCHAMP

my chance—a significant new technology in its infancy. Don't blow it!"

At the time, I assumed that other artists would be equally aware of the horseless carriage syndrome—that, like me, they would try to define a computer aesthetic based on the unique properties of the machine. I soon discovered how naive I was. In 1983, I came down to the States for my first computer art conference and found the place dripping with digital paint. There were lectures and workshops on it: the history of paint programs, how to use paint, the mathematics of digital brushes for pushing digital paint. They had taken the most sophisticated technology the world has ever known and made a hairy stick out of it.

As I later found out, this was not an isolated occurrence. All over the country, powerful computers are churning out weak imitations of post-impressionist paintings and images that look like photographs—not interesting photographs, but pictures of checkerboards with shiny hovering balls that remind me of the lawn ornaments they sell at roadside stands in the Missouri Ozarks. And in digital music, large amounts of money and years of work by dozens of engineers throughout the country have been invested in an effort to make computers sound like violins. Given the resources, you could make a Volkswagen microbus sound like a Stradivarius, but why would you want to?

I want to see what happens when a computer is allowed to be itself—not forced to function as a paintbrush or a camera or a lump of charcoal. Figuring out just how to do this has kept me busy ever since that first show in Halifax. Each work I do tends to explore different elements of the computer and different facets of its relationship to the database we call culture.

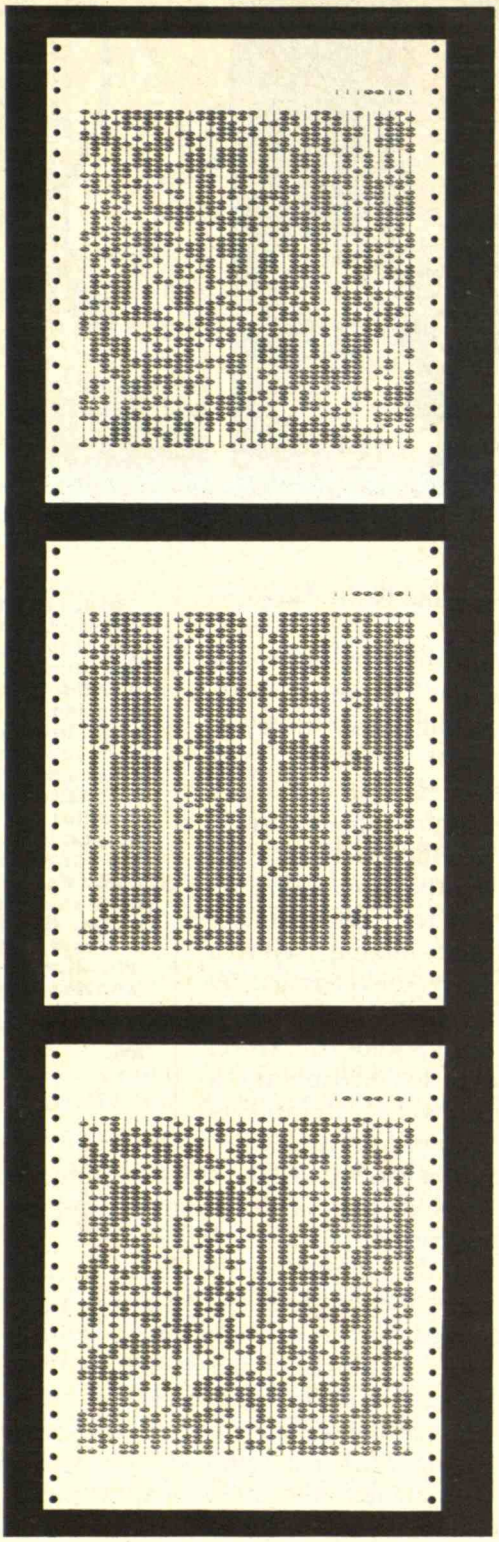
The Machine Is the Subject

The work that best illustrates my ideas is the piece I now call—among other things—SCHOOL OF ATHENS (AFTER RAPHAEL). It is the Halifax memory dump in its current form, having been through many incarnations. Along the way it has accumulated many dimensions, linking itself to a wide variety of references in art history and art theory, philosophy, and literature. I've tried to incorporate a broad range of metaphors about computers and computing into all aspects of the work: its subject matter, its generation, the way I present it, and the way I present ideas about it.

Just as many photographs of the nineteenth century imitated painting (this page, left), so does much computer art today (opposite page). Another approach is to treat the computer much as surrealist Marcel Duchamp did the ordinary bicycle wheel (above), transforming an everyday object into a work of art.

To find the subject for the piece, I reached into the core of the Apple itself. This was originally a matter of convenience, a quick way to fill space in the Halifax exhibit. But the core dump serves another purpose as well. I want to know where things are in the computer's memory, to have an intimate sense of my workspace and its contents, and the dump tells me just that: it is a map of the machine.

I used a very simple program that any third-grader could write. An Apple has 65,536 bytes of memory, and it was a trivial matter to say to the machine, "Count from memory address 0 to memory address 65,535, fish out the numbers stored there, and send them to the printer." In the first printout, the data at each memory location, each byte of memory, was displayed in hexadecimal (base 16) numbers. Be-



Portions of a memory dump from an Apple IIe show the pattern of bits in the operating system and the read-only memory (above), as well as in the text and graphics buffers (far right). The design of the 0s and 1s produces the effect of an abacus.

cause all you saw was an undifferentiated stream of digits, the structure of memory did not become visible. I eventually revised the program to print out each of the eight bits in every byte as a zero or a one, and a distinct sense of place emerged. Now you can tell what's present in different regions of memory by the way the image looks.

Large blocks of zeros or ones indicate unused memory. Regular columns of digits signify text characters, the readable stuff that appears on the screen. And random-looking mixtures of ones and zeros stand for program code: the operating system (DOS 3.3), the code on the printer card that is sending the dump to the printer, the BASIC language interpreter, the ROM code, and of course my own code.

To acknowledge my debt to the software authors quoted in the dump—Steve Wozniak and others at Apple, Microsoft, and Orange Micro—I enclose the whole piece in large quotation marks.

I owe another debt as well: to Marcel Duchamp and John Cage, whose powerful influence in twentieth-century art and music allowed me to see the possibilities in a mass of computer code. There was nothing new in creating a binary memory dump; programmers and engineers used to do this all the time when there was a malfunction. It appealed to me precisely because it had no glamour in the field of computing, and no history in the world of art. I'm grateful for the ground broken by works like Duchamp's *Bicycle Wheel,* a sculpture consisting of an ordinary bicycle wheel mounted on a stool, and Cage's *4′33″*, whose title denotes a length of time in which the audience hears nothing but random ambient noise. Such pieces seem to constitute a permit to use the stuff of everyday life, processes outside the arts that may have unpredictable or unconventional outcomes, as material for art making.

Expressing the Inexpressible

Of course, it's one thing to exhibit a solid object such as a bicycle wheel. But it's quite another to display something as tenuous as the memory of a computer. Everything in it is a code created through the transformation of a code by yet another code. There are no original "thingy" things. The territory consists entirely of maps that refer to no territory, but only to other maps. How do you present something that does not, in any concrete sense, exist?

The question of what physical material to use was fairly easy to answer. The scale of the work required putting together long strips of tractor paper, but I also liked the look of it. When I was a boy, my father, who was a mathematician, used to take me to the computer labs at the University of Illinois. I loved

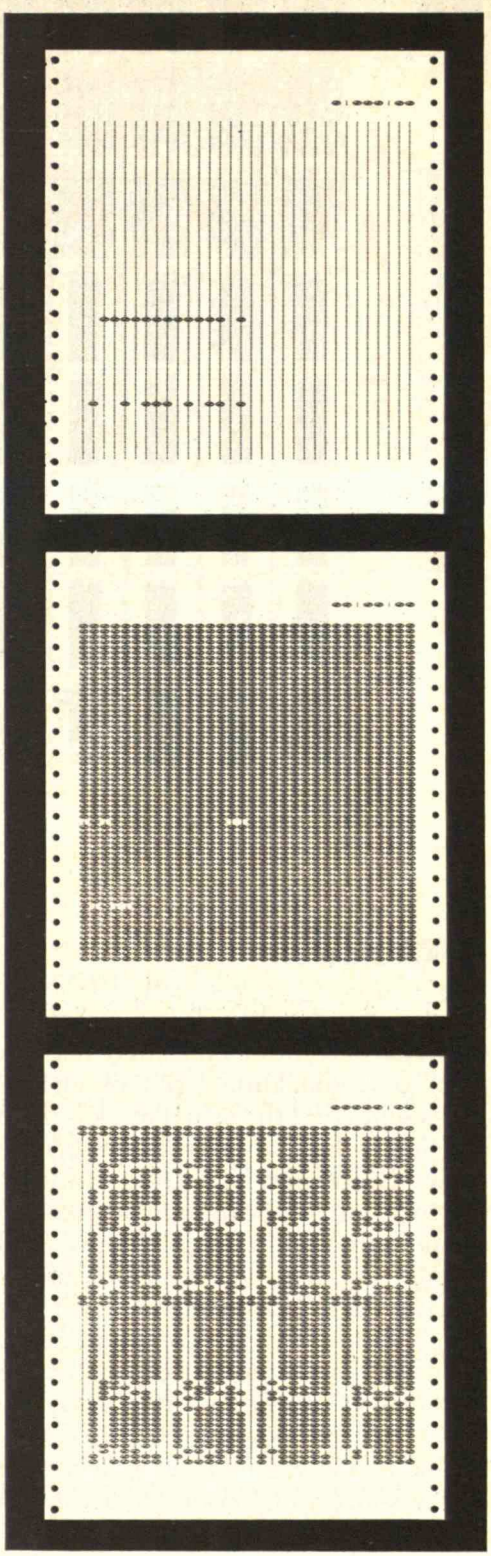
to watch the tractor paper coming out of a line printer and piling up on the floor—advancing and folding, advancing and folding. For me, tractor paper absolutely and unmistakably signifies computing in a way that no other form of output does. Many computer artists exhibit prints made from slides of screen images, but these seem too far removed from the processes and materials of the medium. Everyone knows what tractor paper is and where it comes from. And it is valueless—unprecious as art and nearly as fragile as the electronic data it represents.

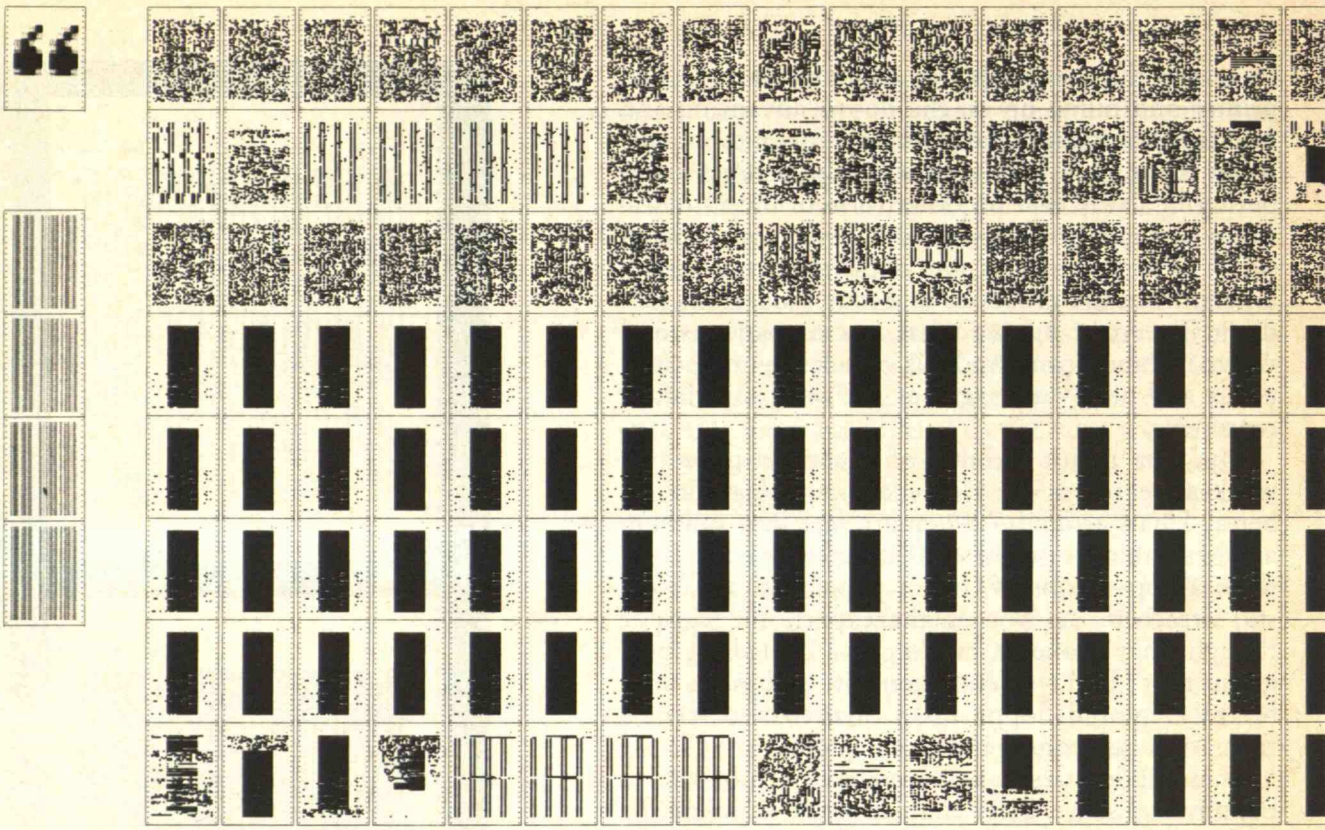
My first major exhibit of computer-generated work appeared at the University of Calgary in Alberta. I had around 700 square feet in a museum and was able to produce 10 different pieces. I put them all up—strips of tractor paper with the holes still attached. As you might expect, the curator thought they looked a bit flat. So I copied the programs that I had written to generate each piece onto brightly colored floppy disks, matted and framed them, and hung them beside the pieces.

These added depth to the work, but not just in the physical sense. They enabled me to highlight the ambiguity—and perhaps the absurdity—of the piece: I don't really know where the art is; all I know is that my work, my physical effort, is on the disk. So it's the disk, not the printout, that gets framed and mounted in the traditional way.

The curator also worried that her audience would be unable to understand my work. She had a point. Anyone would be baffled by an eight-foot diagram of a byte of information with the zeros and ones replaced by Necker cubes (those psychology-textbook diagrams that appear to flip-flop between two different perspectives). Several days before the opening she said, "You're going to have to explain yourself." This was like the earlier problem of making big art in a hurry, with the added complication that in a sophisticated establishment, explanations are considered tasteless. They also invite the audience to argue with the artist, and to accuse him of being didactic. It is far safer to be entirely mysterious.

On the other hand, I like to keep people happy. I went ahead and explained myself. But I did it in a way that became part of the pieces. I wrote funny stories that were parodies of myself becoming a computer artist, and that described in considerable detail the processes I went through to arrive at the pieces. The character in the stories is an overly optimistic bumbling artist whose aspirations far outreach his capabilities. The story is like documentation, the user manual, one of many possible ways to codify the concept of the piece. I've integrated stories into my work ever since.





The Power of Names

As one looks at and thinks about computer works, their substance becomes increasingly nebulous. The more types of codification I put on the wall, the clearer it becomes that the actual work is not present, and the clearer is the shape of the intangible territory occupied by its absence. Titles, like stories, are just one more form of codification. They have come to play an especially important role in my work.

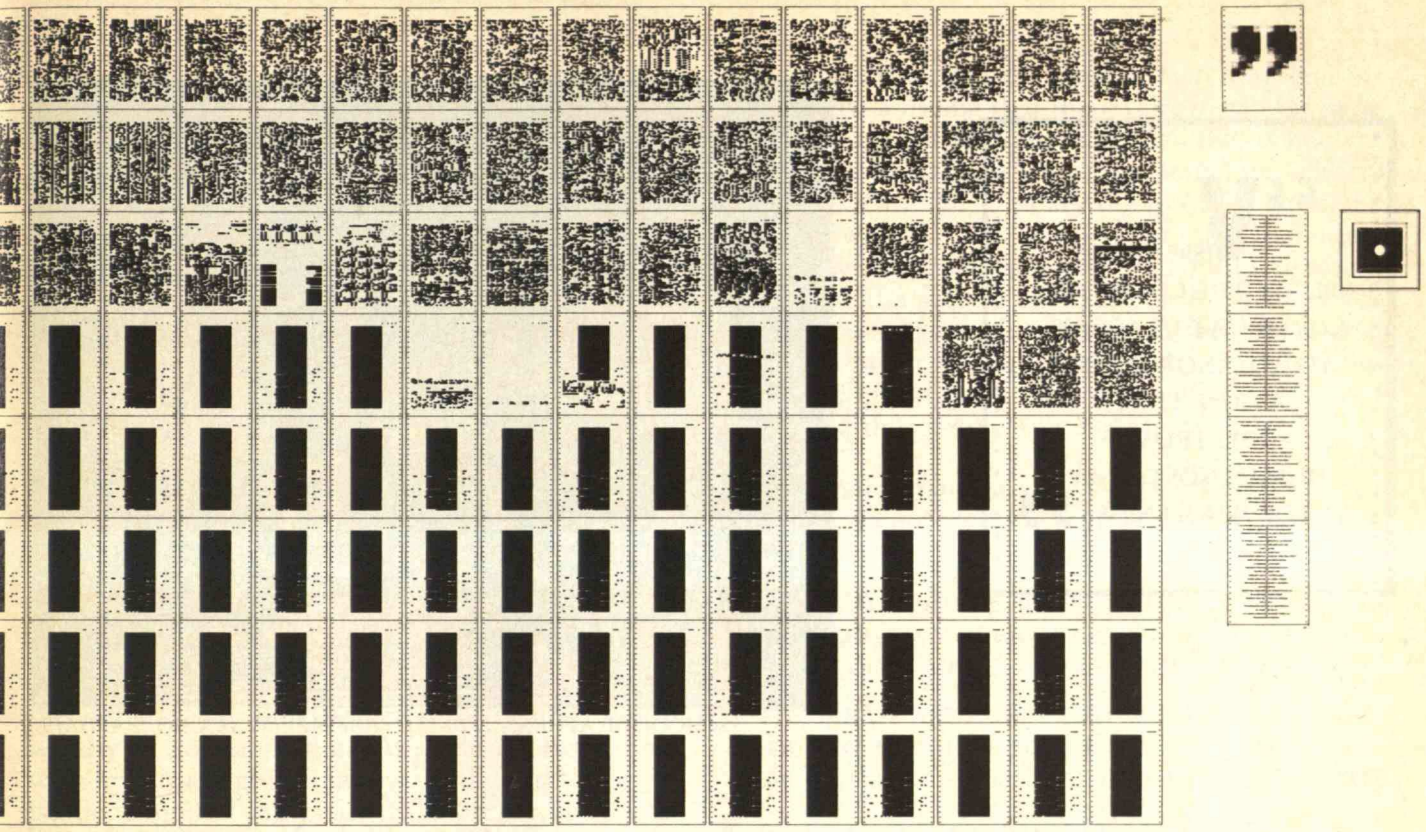
When I did my first memory dump in Halifax, I needed a name for it. I thought about SELF PORTRAIT, because in a funny way the computer had taken a picture of itself. Then I thought of a more interesting one, THE MACHINE EXAMINES THE STATE OF ITS MEMORY IN THE ACT OF EXAMINING THE STATE OF ITS MEMORY, because it was a self-referencing operation.

Time was short and I couldn't decide which to use, so I gave up and used both. I stuck an "or" between them, the way nineteenth-century writers did when they came up with titles like "Ode to an Oaken Bucket, or How I Lost My Lover." Once I had presented two titles and survived, the door had been opened. I continued thinking of new implications of the memory dump, adding a title for each one.

Multiple titles helped me with another problem. Works of art that mean just one thing look flat and lifeless. What allows a work to seem like a living thing is a multiplicity of possible meanings; each time you see it, the work becomes a fresh combination of its own possibilities. A tree can be anything to anyone who comes along. Though I couldn't hope to produce that much potential for meaning (only God can make a tree), a long list of provocative titles seemed like a way to start.

In a way, the titles are to the printout as software is to hardware. Every time I change the software on my computer, I become conscious of the hardware as something different—as my departmental budget, as a paintbrush, as a musical instrument. Likewise, each title makes me conscious of the printout as a different thing. Even though the piece itself hasn't changed, my perception of it has.

Over the years, the memory dump has acquired about 150 titles. I usually edit them back to 64, a power of two, for exhibition. Each showing seems to conjure up different titles. For the 1985 Siggraph conference and art exhibition in San Francisco, I invested considerable effort and money in designing, producing, and installing a new 256-square-foot version of the memory dump. About two days before



SCHOOL OF ATHENS (AFTER RAPHAEL), *1985-1987; HUBERT HOHN COMPUTED SIMULATION FOR AN 8-BY-32-FOOT INSTALLATION*

the opening, I was informed that the $3 entrance fee to the exhibition would be waived, but not the $800 conference fee. They were completely immovable on the subject, to the extent that I was not allowed to enter a session in which my own work was under discussion. The first title on the list in that context was:

ITS ARTIST FAILS TO GAIN ADMISSION TO THE PROCEEDINGS DESPITE THE MAGNITUDE OF HIS CONTRIBUTION.

Here are a few of the other titles:

AN APPLE IIe DISPLAYED ON A 6,336 X 40,960 PIXEL FRAME BUFFER

This one was also inspired by the Siggraph show. The size of the pixel array—the number of dots that make up a computer image—determines the amount of resolution you can get. There was a lot of "My pixel array is bigger than your pixel array" kind of talk going on around there, and my tiny Apple pixel array wasn't even big enough to merit attention as an object of derision. Then it occurred to me that the real pixels in my work were not the dots my computer was capable of displaying on a screen but the dots my printer deposited on the tractor paper. When I counted up the resolution for 256 sheets of paper, I realized that I had a bigger pixel array (259,522,560 pixels) than anybody, by at least two orders of magnitude. The title helped me hold my own in a context where size was everything.

BLUEPRINT FOR A VLSI ABACUS

The work of computer art shown here at a greatly reduced scale is a simulation of an entire Apple IIe memory dump. Each of the 266 rectangles represents a sheet of computer paper. The framed floppy disk above stores the programs used to generate the printout.

VLSI (very large-scale integration) was another bit of jargon the technology folk were throwing around at one point. Because they can enhance pixel arrays, VLSI chips are to a computer artist what steroids are to a bodybuilder. I intentionally designed the zeros and ones so the printout looks like an abacus; the zeros are heavy and flat, and the ones stack up like rods. I also made the ones concave, so the space between them is shaped like a zero, and the space between zeros is shaped like a one. In addition to the abacus look, this gives a flip-floppy, gestalt kind of visual effect.

> "VISIONARIES BELIEVE THE COMPUTER COULD GIVE US ACCESS TO ALL KNOWLEDGE, A HOPE THAT ARISES FROM A HUMAN NOSTALGIA FOR WHOLENESS."



SCHOOL OF ATHENS, *1510-1511; RAFFAELLO SANZIO (RAPHAEL)*

TITLE #2

A computer, loosely defined, is a bunch of switches, ons and offs. All the data in a computer is made up of combinations of these two states, represented as zeros and ones. Gottfried Wilhelm Leibniz, the late-seventeenth-century philosopher and mathematician, attempted to construct a mystical cosmology based on this binary counting system. God was one, was being, and nothingness was zero. All other things in the universe were compounds of the two.

Anything that has two states becomes interesting to me when I am in computer artist mode. There are all kinds of dualisms, or binary oppositions, in the content of life and art: good and evil, heaven and earth, faith and reason, self and other, inner and outer, illness and health, male and female, citizen and state, war and peace, justice and injustice, dominance and submission, left and right, stochastic and deterministic. How better to explore binary opposition than with a machine that is *made* of binary opposition?

I play with parody and irony in my work because they involve duality of text. Many of the titles invite parodic readings of the dump. THE MACHINE SEEKS THE ORIGIN OF ITS CONSCIOUSNESS turns the self-referencing of the machine into a parody of a quest for the inner self. Other titles have dual meanings. THE GLASS BEAD GAME refers on one level to the novel of the same title by Herman Hesse, in which a group of ascetics try to construct a symbol system that can represent anything and everything—the idea of a computer. But on another level it refers to actual glass beads—either the abacus suggested by the ones and zeros or the silicon chips that make up the machine (a sort of dualism within a dualism).

Over time, as I expanded the memory dump for different exhibits, the titles became more and more integrated into the piece; they were teetering between merely *indicating* the content and actually *being* the content. I couldn't decide in which direction to push them. As had happened so often in the past, the solution arrived by accident—and it gave the piece another layer of dualism.

In a programming class at the Mass. College of Art, I wanted to show people where things were in the Apples they were using. I put my map, the memory dump, on the wall. But rather than simply point to the different sets of code, I decided it would be clearer to print out a list of the actual functions of all the pages of memory: graphics buffer, text screen memory, and so on. I took down my usual titles and put up this functional classification. The functional list was still on the wall when there was an open house at the college. Assuming that art folks would be bored by these titles, I replaced them with the other list, the "real" titles.

Then I realized that I had not two separate things, but one thing with two states. I had two distinct ways of being conscious of memory, two ways to approach the naming of memory, and an all-encompassing level of binary opposition. The memory dump was a symmetrical piece, and I had been dis-

playing either the right-handed version or the left-handed version. Now when I hang the memory dump, I display the whole piece. On one side I put the classification that defines the structure, and on the other I hang the titles that suggest possible meanings—the metaphorical references to the Platonic memory dump that can never really be there at all.

The Human Database

Since the original list now had a mate, the titles became unequivocally part of the content. But I realized that I needed a title to cover the whole array of parts. Being unembarrassed to borrow heavily from others (it's actually the fashion nowadays), I called it SCHOOL OF ATHENS (AFTER RAPHAEL).

In the center of Raphael's fresco *School of Athens,* there is an archway with Plato and Aristotle standing side by side. Plato is on the left with the *Timaeus* in hand, gesturing toward the sky, which is visible in the archway. For him, heaven is the source of ideas worthy of contemplation. Aristotle is on the right with his *Ethics,* gesturing toward the earth. For Aristotle, temporal things are more proper objects for attention. The concept seemed to fit the memory dump perfectly: here I have my Platonic titles, my references to the ideal, unknowable, and absent memory; and there I have my Aristotelian titles, my references to the concrete, observable, and present memory. But the link with Raphael seemed apropos in an even more important way. In the foreground of *School of Athens,* the Greek philosophers of all periods are gathered in an encyclopedic performance. Socrates, Pythagoras, Euclid, Homer—they are all there. It is a rendering of a wonderful human database, a way of representing all the things the Greeks discovered and knew.

Since their conception, computers have been idealized by visionaries in a similar way, as potentially providing us with access to all knowledge. Every computer is what can be called a universal Turing machine, after the theory advanced by the English mathematician Alan Turing in 1936. Turing showed that all kinds of logical problems could be solved with a machine that used binary coding, obeyed a finite set of rules, and had unlimited data storage. He also proved that any such machine could simulate the performance of any other such machine. Since it is theoretically possible to code a Turing machine to simulate almost any form of knowledge, and since a Turing machine can be coded to simulate any other Turing machine, a Turing machine can be coded to represent anything and everything—and we are back to Raphael but also Hesse and Leibniz. Indeed, the machine, the painting, the novel, the cosmology all appear to arise from the same human nostalgia for wholeness: a feeling that there is power in bringing together (at least metaphorically) all that is known.

SCHOOL OF ATHENS (AFTER RAPHAEL) was clearly the perfect title for a binary dump of a computer's memory with two lists of titles. But it began to seem inconsistent to have only one "metatitle." I would have to find a second one. I decided to reach back to the roots of my theorizing—to the proposition that it is better to look at what the machine does than to copy what paintbrushes and cameras do. I embodied this principle in a multipart title:

A BIT OF PHENOMENAL NONSENSE DESIGNED TO TEST THE FOLLOWING TWO-STATE HYPOTHESIS OR NECKER HUNCH:

0. A DIGITAL MACHINE AND ITS PROGRAMS ARE MORE ANALOGOUS TO A WORK OF ART AND ITS TITLES THAN TO THE TOOLS AND EFFECTS OF DISCIPLINES.

1. A WORK OF ART AND ITS TITLES ARE MORE ANALOGOUS TO A DIGITAL MACHINE AND ITS PROGRAMS THAN TO OBJECTS FROM THE HISTORY OF PICTURES.

And the question arises, Why stop there? The last time I exhibited the piece, I included still another pair of metatitles:

A BINARY DUMP OF THE ENTIRE MEMORY OF AN APPLE IIe (AFTER WOZNIAK)

A TALE TOLD BY AN IDIOT, FULL OF ONES AND ZEROS, SIGNIFYING NOTHING (AFTER SHAKESPEARE)

The titles have become an encyclopedia of ideas brought into relationship with each other by the presence of the memory dump. It is extraordinary to me that my quest for an art form based on the essence of the computer should have led to such disparate sources as Raphael, Hesse, Zen Buddhism, Plato, Douglas Hofstadter, Descartes, Wozniak, Shakespeare, Turing, and on and on.

But now I have to be honest. While I was telling you about Turing's concept of the machine as ultimate simulator, I felt the rug slipping out from under my argument. I had set out to examine the essence of the machine, only to find that the essence of the machine is simulation. The machine is truly itself when it is something else. In avoiding one trap, I have fallen into another, and being a purist am now stuck with simulation. But I am working on a new hypothesis, that perhaps the machine is meant to simulate not what has been but what is yet to be—our unarticulated hopes. This time I will do the titles first. □

Activist Governors, Star Wars Scientists

The Politics of Innovation

Laboratories of Democracy
by David Osborne
Harvard Business School Press, $24.95

Reviewed by Robert Howard



According to historian Arthur Schlesinger, Jr., American politics alternates between periods of "public purpose" and "private interest." For those curious about the form of public purpose most likely to succeed the anti-government principles of the Reagan years, this informative book is a good place to begin.

Journalist David Osborne points out that while the Reagan administration has been cutting federal programs and championing free-market ideology, governors across the nation have been experimenting with new forms of public activism and economic intervention. Just as states and cities in the Progressive era devised programs that were later translated into national policy during the New Deal, today's "laboratories of democracy," says Osborne (borrowing a phrase from Louis Brandeis), are laying the foundation for "an emerging new paradigm" in American political life.

Laboratories of Democracy takes a detailed look at the policies and practices of six former and current governors—Republican Richard Thornburgh of Pennsylvania and Democrats Bill Clinton of Arkansas, Bruce Babbitt of Arizona, James Blanchard of Michigan, Mario Cuomo of New York, and Michael Dukakis of Massachusetts. Osborne's preoccupation with the acronym-infested minutiae of their programs and initiatives is sometimes daunting. But on the whole he succeeds at communicating the extraordinary creativity of a new generation of policymakers.

Creating Economic Growth

The initiatives of the Progressive era were an attempt to cope with the social problems caused by rapid industrialization. According to Osborne, today's activist state governments are responding to the effects of stiff international competition and nonstop technological change.

New economic and technological realities, he argues, transcend the political assumptions of both social-welfare liberalism and laissez-faire conservatism. What's needed are government policies designed to strengthen the capacity of American society to innovate.

Osborne's governors have worked to improve the intellectual infrastructure of their states by expanding university systems. They have encouraged industrial modernization by backing not only the development of technologies but their deployment in local firms. And instead of counterproductive "smokestack chasing," in which states compete with one another to lure new factories, they have supported homegrown entrepreneurialism by providing technical assistance and even risk capital to promising start-ups.

Nowhere in these pages is the range of such initiatives more dramatically demonstrated than in the example of Michigan. In the late 1970s and early 1980s, the state's economy was on the verge of a depression, with the highest unemployment and worst bond rating in the nation. But since the election of Governor James Blanchard in 1984, Michigan has adopted a variety of new mechanisms to stimulate economic growth and create new jobs.

Soon after coming to office, Blanchard commissioned a comprehensive analysis of the state economy. The study concluded that Michigan should build on existing strengths in durable-goods manufacturing to become a center for the design and development of advanced industrial technologies.

Blanchard's administration also initiated programs to help new entrepreneurs—crucial in a state like Michigan whose economy has been dominated for more than half a century by the auto giants. With an income of $20 million per year from oil and gas leases on state land, the Michigan Strategic Fund supplies capital to new businesses not profitable enough for private investors but too risky for conventional bank loans. In addition, the state has become an active player in the private venture-capital market through the Michigan Venture Capital Fund. Financed by 5 percent of the state's pension savings, about $800 million, this fund enters into partnerships with private venture capitalists to invest in the state's most promising new businesses. "By sharing deals with the largest private funds in the country," writes Osborne, the fund "is able to showcase Michigan's start-ups from coast to coast."

Michigan has also provided assistance to existing small manufacturing companies. For example, the Michigan Modernization Service is a "comprehensive industrial extension service" modeled on the agricultural extension services created in the nineteenth century. With a yearly budget of $5 million, 27 full-time employees, and more than 30 field representatives, it helps Michigan manufacturers upgrade their production technologies, retrain their workers, revamp their labor-management systems, and find new sources of investment capital.

While it is much too soon to know the precise impact of such programs, Michigan has already developed a dynamic sector of technologically advanced small manufacturing firms—including the largest concentration of machine-vision and robotics companies in the nation, in the corridor between Detroit and Ann Arbor known as Automation Alley.

Bringing the Poor into the Process

But as admirable as Michigan's efforts are, they have done little to address the severe problems of a city like Detroit. "Even the best economic-development system," Osborne admits, "will not do a great deal for the poor," because disadvantaged social groups face unique barriers to entering the labor market. Thus, his new political par-

ILLUSTRATIONS: KAREN STOLPER

Government can encourage both economic competitiveness and social justice.

adigm has a "second agenda"—bringing the poor into the economic-development process.

This makes both economic and political sense. No economy can effectively compete when a major portion of its society is unproductive. And only a program that speaks directly to the interests of disadvantaged groups can command the broad political support necessary to become a model for the whole nation.

Osborne's chief example of how his second agenda might work is Massachusetts, home of Democratic presidential candidate Michael Dukakis. "More than any other governor," he writes, "Dukakis made a concerted effort to bring poor communities and poor people into the growth process." This was partly the result of the state's economic good fortune. When governments do not face the immediate challenge of creating growth, they can concentrate on distributing it more evenly.

Osborne describes how the Dukakis administration has brought economic growth to declining cities and regions and established initiatives such as the much-publicized Employment and Training Choices program, which helps welfare recipients become productive members of the state economy. He gives the governor mixed marks. On the one hand, older industrial cities, including Lowell and Fall River, have benefited from the state's efforts to distribute economic growth more evenly. And programs like Employment and Training Choices have demonstrated that "the more money government invests in education, training, and providing supported-work environments for welfare recipients, the greater the payoff will be," Osborne notes.

On the other hand, he believes that since Massachusetts has not created the "comprehensive, long-term development strategies or institutions" of states like Michigan, the government may eventually have trouble coping with poverty. Part of the problem is that Massachusetts, a pioneer in many of the initiatives described in this book, has paid the price of being first. Its approach to economic development has been relatively ad hoc, whereas other states have been able to learn from its experience. But poverty may also be the most intractable of the challenges facing the new paradigm, and the ultimate test of its suitability as a national political program.

The Dukakis presidential candidacy has brought many of the ideas of the new paradigm to national politics and may take them to the White House. What role should the federal government play in encouraging economic growth and bringing its benefits to all citizens?

As Osborne rightly emphasizes, it is not simply a matter of creating national programs that replicate what some states are doing on the local level. The reason is that innovation rarely works when it is controlled from above. In a twist on the familiar political slogan, Osborne argues that all economics is local. Encouraging innovation requires a sensitivity to local conditions and regional strengths and weaknesses. Therefore, those who create national policies have to be careful not to smother local initiative with centralized bureaucratic uniformity.

Of course, this is not to say that there isn't a great deal the federal government can do. Take the simple example of unemployment compensation. According to one estimate, the United States spent roughly $30 billion a year to pay for the cost of unemployment at the peak of the 1982 recession, but only about $5 billion to retrain workers and create new jobs. In Sweden, by contrast, the ratio is reversed, with the vast majority of funds used to subsidize retraining and reemployment through a network of locally controlled regional labor-market boards.

Osborne may overemphasize the centrality of local economies and new entrepreneurs to maintaining stable economic growth. In a recent article in the *Harvard Business Review*, M.I.T. researcher Charles Ferguson chalked up the failures of the U.S. microelectronics industry to "chronic entrepreneurialism," which hampers firms' capacity to compete internationally. In a world economy dominated by national and multinational giants, government may have to do far more than create the conditions for local growth.

Still, *Laboratories of Democracy* highlights perhaps the key political challenge of the last decade of this century: how to encourage innovation without leaving whole segments of the population behind, how to use the "public purpose" of government to further not only economic competitiveness but also social justice.

ROBERT HOWARD is a senior editor of Technology Review.

The Press and Star Wars

Claiming the Heavens
by Philip M. Boffey, et al.
Times Books, $17.95

Reviewed by Gerald M. Steinberg

Ever since President Reagan announced his goal of making nuclear weapons "impotent and obsolete," the Strategic Defense Initiative (SDI) has been at the center of controversy. Perhaps for the first time in the postwar era, Congress and the press have questioned the advisability of a major new strategic weapons system while it was still in the early stages of research and development. As the title suggests, *Claiming the Heavens: The New York Times Com-*

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Journalists persist in seeing scientists as somehow beyond politics.

plete Guide to the Star Wars Debate is a compilation of that newspaper's coverage of the issue. It examines the origins, scientific and technical aspects, and arms-control implications of Star Wars, and presents the various cases for and against the program.

But at the heart of the book is a curious paradox. The Star Wars story is, at least in part, about the politicization of American science. And yet the press reports collected here suggest that journalists still have a naive and apolitical view of science and scientists.

Playing the Press

Scientists on all sides of the Star Wars debate have attempted to play the press for their own political agenda, but the ones who are pro-SDI have enjoyed an advantage. In April 1985, when political opposition and doubts about technical feasibility threatened to slow work on the x-ray laser, Edward Teller and Lowell Wood, Lawrence Livermore Laboratory scientists who supported the weapon, leaked news of a "major breakthrough" that was widely reported in the media. Other scientists, including Roy Woodruff, head of weapons programs at Livermore at the time, found these accounts "overly optimistic" and "technically incorrect." But since Woodruff did not have Teller's access to the press, the details of his objections were not publicized until two years later. By that time, the issue had faded from the public agenda and the x-ray laser project had continued.

In September 1985, the press also reported the "spectacular success" of the MIRACL chemical laser. Pictures of a Titan target missile, supposedly destroyed by the laser, were shown repeatedly on television news shows and reprinted in thousands of papers and news magazines. Months later, critics in the scientific community were able to demonstrate that the Titan had been doctored. But their criticisms did little to counter the stark image of an exploding missile.

Of course, the use of a well-placed leak to further one's own objectives is a familiar strategy in political controversies. In this respect, Teller and others were acting like any self-interested government bureaucrat would. And the proponents of SDI were not alone in manipulating the press for their own ends. Early in the debate, SDI critics Hans Bethe and Richard



Garwin told reporters that hundreds of "space battle stations" would be necessary for SDI to work—a claim they were later forced to revise downward on the basis of what they called a recalculation.

Wizard Scientists, Flashy Techniques

What is surprising is the credulousness with which the press handled such statements. Part of the reason is that journalists persisted in seeing both pro- and anti-SDI scientists, according to a well-worn stereotype, as somehow beyond politics. Throughout this volume, the authors treat the scientists involved in the controversy with a sense of reverence—like wizards whose secrets are beyond the ken of ordinary human beings. Peter Hagelstein, "father of the nuclear-powered x-ray laser," is portrayed as "a young genius" who subsisted for years on peanut-butter sandwiches and "worked night and day" on "exotic" calculations.

Even when these journalistic portraits are less than complimentary, it is merely to evoke another familiar stereotype—the "mad scientist" who is socially inept and, perhaps, politically dangerous. According to William Broad, Hagelstein continued to work on the x-ray laser despite his misgivings about it, because to quit "would mean giving up what had become his home, leaving the 'only place where he had ever been understood.' " But the negative image, like the positive one, has the same result: to romanticize scientists and mystify science.

This tendency is reinforced by a preoccupation with the technical aspects of the Star Wars issue, which at its worst becomes a fascination with flashy technologies, the more unusual the better. For example, the chapter "The Dark Side of Star Wars" emphasizes the unlikely possibility that SDI lasers could be used as "death rays" to destroy enemy cities or even perform "selective assassinations" of Kremlin leaders "watching the annual May Day parade." Many factors make such scenarios highly implausible, and the emphasis given them here is not warranted by the evidence. But journalists—much like SDI enthusiasts—still seem to view science and technology as a magical realm where anything can happen.

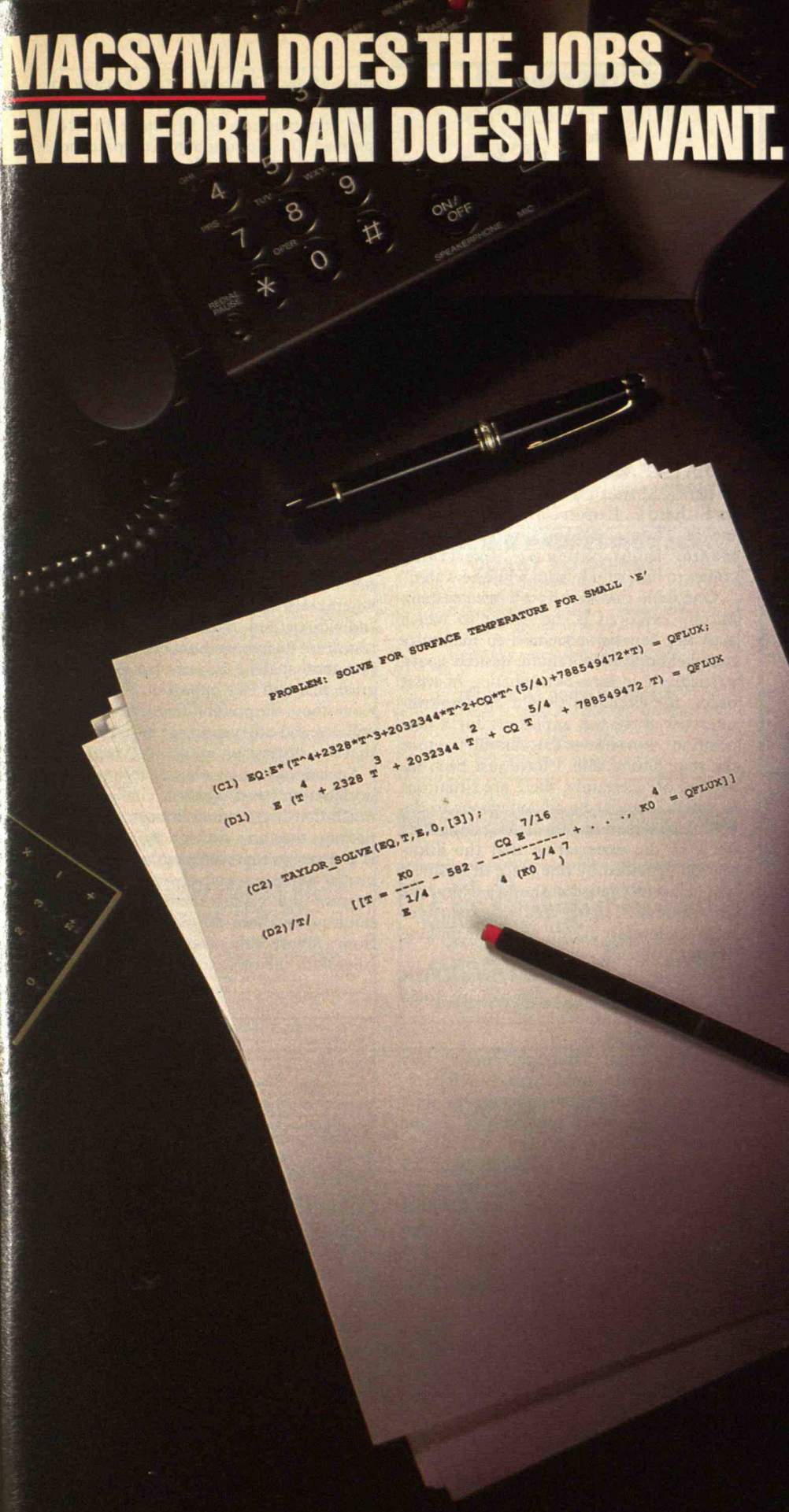
Demystifying Scientific Debate

Fortunately, while many journalists have been mythologizing science, some scientists have been trying to explain it. One of the most interesting and least noticed aspects of the SDI debate has been the degree to which the activities of scientists and others in the technical community have themselves served to demystify the scientific process and debate. Many scientists, particularly critics associated with groups such as the Union of Concerned Scientists, have published articles directly in newspapers and magazines explaining both the technical and political aspects of Star Wars. Dispensing with the journalists as intermediaries, they have explained the issues and their own perspectives before a variety of public organizations. This is an important first step in improving the quality of debate and people's understanding about politicized scientific issues.

Unfortunately, it may be unrealistic to expect scientists to completely separate their professional judgments from their ideological purposes. But at least we can expect the press to give up the pretense that science and politics constitute independent worlds.

GERALD M. STEINBERG specializes in science and technology policy at Hebrew University in Jerusalem and is the editor of Lost in Space: The Domestic Politics of the Strategic Defense Initiative *(Lexington Books, 1988).*

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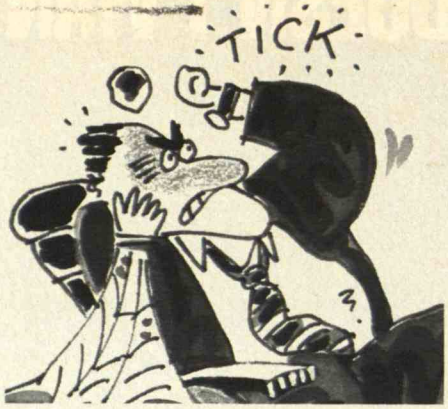
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LETTERS

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CREATIVE WAITING

"There's More to a Line than Its Wait" by Richard C. Larson (*July 1988*) reminds me of Thomas Edison's version of the maxim about patience: "Everything comes to him who hustles while he waits."

One issue that still hasn't been systematically explored is the extent to which activities can be sequenced to maximize the likelihood of obtaining desired goals, particularly in long-term queues. In what order, for example, should an employer interview three top applicants for a new position? In what order should I return the four phone calls I have just been informed of? Certainly, there are situations in which it might be advantageous to deliberately sequence calls, visits, or agenda items in the expectation that the information provided by one piece of business will be useful input for another within the same queue. Highly skilled executives seem to develop a keen sense for making the most of such opportunities.

WILLIAM E. COOPER
Iowa City, Iowa

BUMP DESIGN

In the Minitrend "Dump the Bump" (*July 1988*), it is conjectured that a church parking lot in Miami might contain the only rationally designed "speed hump" in the United States. Not so!

Way back in 1952 I was teaching an evening post-graduate course in linear dynamics when I decided that the traditional 12-inch-wide speed bumps on the campus of Washington University in St. Louis would make a good case study. The students and I went out into the parking lot and bounced up and down on the bumpers of several cars to determine the resonant frequency of a typical suspension. Then we calculated the wavelength of a single-cycle, sinusoidal bump that would give the maximum vertical acceleration to the occupants of the car at 20 miles per hour.

I sent the design of our optimum bump to the director of our physical plant, and promptly received a courteous reply. Our chancellor, Nobel laureate physicist Arthur Holly Compton, had already designed such a bump, which was scheduled for construction in the near future. I phoned Dr. Compton to compare notes and found that our designs were similar except for two features. We congratulated each other on our perspicacity.

Several years later, on returning to the St. Louis campus for a seminar, I tested the by-then notorious "Compton bump." At 15 miles per hour it nearly threw my Chevrolet into a somersault.

G.W. SWENSON, JR.
Champaign, Ill.

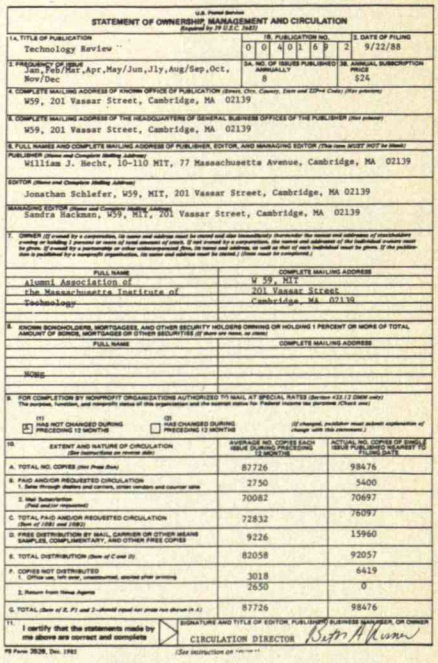
WINNER

CONTINUED FROM PAGE 19

robot world can provide us with all our hearts desire.

Finally, this imagined world is, as the name "Transformers" suggests, a place where constant change is taken for granted. Individuals and entire species effortlessly transform themselves from one kind of thing into another at the drop of a hat. For a generation that will face important ethical decisions about the possibilities offered by gene splicing and other forms of biotechnology, that is a distressing model to consider.

Such images of violence, technological domination, and reckless change reflect much that is unsettling in our culture. But perhaps they now do even more than that. Is it possible that our playthings not only mirror current social obsessions but also nurture and sustain them? It makes one think twice about the slogan I first heard from a Silicon Valley engineer: "He who finishes with the most toys wins." □



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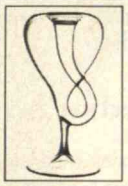
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Getting to Yes on Waste Incineration



A work by nineteenth-century Black sculptor Edmonia Lewis reappeared in a Chicago junkyard recently.

Rediscovered Art

M.I.T. writing professor Marilyn Richardson has located *The Death of Cleopatra*, a lost sculpture by the renowned nineteenth-century Black artist Edmonia Lewis. Richardson's query in the *New York Times Book Review* four years ago led her to the statue, which is sitting in a shopping-mall warehouse in Forest Park, Ill.

First exhibited at the 1876 Philadelphia Centennial, the five-foot-high marble sculpture later marked the grave of a horse—named Cleopatra—in the infield of a Forest Park race track. It disappeared in the 1940s, reappearing 45 years later during a fire inspection of a junkyard. "The fire chief was a scoutmaster and he decided rescuing the statue was a good project for his troop," says Richardson. The scout project attracted the attention of the Forest Park Historical Society, which asked New York's Metropolitan Museum of Art for restoration advice. A curator there contacted Richardson.

Environmental Mediation

When technological controversies are politicized, interest groups are often hostage to their own narrow perspective. Because seeing things from an opposing point of view is difficult, finding common ground can be, too. The two-day conference "Hazardous Waste Incineration: Confronting Sources of Disagreement" was a step toward breaking that cycle.

Participants included leaders from industry, government, environmental groups, and professional associations. The dual purpose was to educate the representatives about the positions of others and to explore new modes of individual and collective action. "Answers to the waste-management problem transcend technology," said Dr. John Ehrenfeld, coordinator of M.I.T.'s Hazardous Substances Management Program, which sponsored the conference. "[They] must come from a consensus of all concerned parties."

The 21 conference-goers suggested principles that could help address conflicts over incineration more effectively:

☐ Government, industry, and the public share responsibility for solving waste-management problems, and industry should engage the public in decision making early.

☐ The public won't accept incinerators unless industry and government also use options such as waste reduction and recycling.

☐ Standards need to be comprehensive, covering total emissions, so pollutants are not shifted from one medium to another.

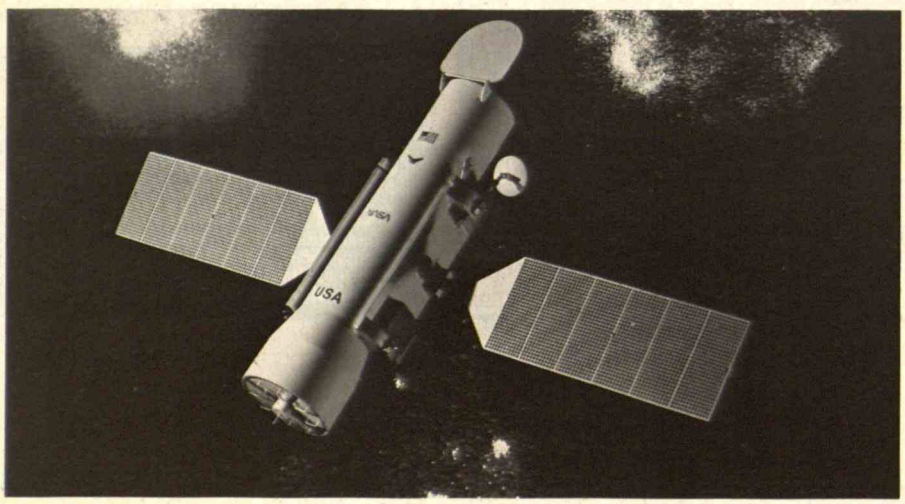
☐ Risk, cost, and benefit analyses must consider social costs and benefits.

☐ Testing of operators should be strengthened to improve service and safety and enhance a proposed facility's credibility.

M.I.T. in TR. . .

A professor of finance at M.I.T.'s Sloan School of Management since 1984, author John Parsons (*page 57*) is one of the few experts in the United States on the banking system in the German Democratic Republic. He speaks of the economies of socialist nations from experience. On four research trips to East Berlin, he has met with socialist economists and bankers, and he reports that while several "key principles of socialist political economy are often hotly debated, the fundamental tenets are not widely questioned."

Hu Hohn comes to *Technology Review* through an exhibit of his unique computer art at M.I.T.'s Compton Gallery (*page 64*). After seeing his creations and reading his remarkable commentary on them, we asked Hohn to share with our readers his challenging questions about the nexus of technology and art.



Congress has given NASA permission for "a staged gradual start" to the on-again, off-again Advanced X-Ray Astrophysics Facility (AXAF). "This is what we've been looking for for many years," reports M.I.T. physicist Claude Canizares, who is the Center for Space Research's principal investigator for AXAF's high-resolution x-ray spectroscopy project.

After AXAF orbits—perhaps in 1996—it should serve the world scientific community for 15 years. In a typical observation, AXAF will point at one spot for many hours to record faint signals. It will be 100 times more sensitive than existing instruments to x-ray sources and about 1,000 times better at resolving detailed features in the x-ray energy spectrum.

PHOTOS: BOSTON ATHENAEUM; COURTESY OF TRW SPACE & TECHNOLOGY GROUP

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